SAMPLING AND ANALYSIS PLAN/QUALITY ASSURANCE PROJECT PLAN FOR GOLD KING MINE BLOWOUT SILVERTON, SAN JUAN COUNTY, COLORADO

Prepared for

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Region 8

1595 Wynkoop Street
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Contract No.: EP-S8-13-01

Technical Direction Document No.: 1508-04

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SAP/QAPP Revision Log

Project: Gold King Mine Blowout
Task Monitors: Steve Way/Hays Griswold
Technical Direction Document (TDD): 0001/1508-04

Date	Revision Number	Reason for Change of Scope/Procedures	SAP Section Superseded

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LIST OF ACRONYMS

°C	degrees Celsius
%D	percent difference
%R	percent recovery
%RSD	percent relative standard deviation
ACM	asbestos containing material
AES	Atomic Emission Spectrometry
ANSI	American National Standards Institute
APP	Accident Prevention Plan
ARAR	applicable or relevant and appropriate requirements
ASQ	American Society for Quality
AST	aboveground storage tank
B	bias
CA	Corrective Action
CB	calibration blank
CCB	continuing calibration blank
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CHMM	Certified Hazardous Materials Manager
CLP	Contract Laboratory Program
cpm	counts per minute
CO	Contracting Officer
COC	Chain-of-Custody
COR	Contracting Officer Representative
Cr+6	Hexavalent Chromium
CRL	Central Regional Laboratory
CRQL	Contract Required Quantitation Limits
CSM	Conceptual Site Model
CVAA	Cold Vapor Atomic Absorption
D	absolute range
DMP/BMP	Region 8 Data Management Plan/Best Management Practices
DQI	Data Quality Indicator
DQO	Data Quality Objective
EDD	electronic data deliverable
EDX	Energy Dispersive X-Ray
ERM	Emergency Response Manager
ERT	Environmental Response Team
ESI	Expanded Site Inspection
FID	Flame Ionization Detector
FS	Feasibility Study
FSP	Field Sampling Plan
GC	gas chromatography
GC/MS	gas chromatography/mass spectrometry
GIS	Geographic Information System
HASP	Health and Safety Plan
HRGC/HRMS	high resolution gas chromatography/high resolution mass spectrometry
HRGC/LRMS	high resolution gas chromatography/low resolution mass spectrometry
HRS	Hazard Ranking System
HPLC	high performance liquid chromatography
ICB	initial calibration blank

LIST OF ACRONYMS

ICP	inductively coupled plasma
IDW	investigation-derived waste
ISTD	Instrument Standard
ITRC	Interstate Technology and Regulatory Council
LBP	lead based paint
LCS	laboratory control sample
LOD	limit of detection
LOQ	limit of quantitation
MDL	method detection limit
mg/kg	milligrams per kilogram
MPC	Measurement Performance Criteria
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
NCP	National Contingency Plan
ND	non-detect
NIOSH	National Institute of Occupational Safety and Health
NPL	National Priorities List
NRCS	Natural Resource Conservation Service
PA	Preliminary Assessment
PAH	Polycyclic Aromatic Hydrocarbons
PAL	Project Action Limit
PCB	Polychlorinated biphenyls
PCDD	Polychlorinated Dibenzo-P-Dioxins
PCDF	Polychlorinated Dibenzofurans
PCM	Phase Contrast Microscopy
P.E.	Professional Engineer
PID	Photoionization Detector
PLM	polarized light microscopy
PM	Project Manager
PMP	Project Management Professional
POC	Point of Contact
PQL	Project Quantitation Limit
PQO	Project Quality Objectives
PT	proficiency testing
PTL	Project Team Lead
PUF	polyurethane foam
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QMP	Quality Management Plan
Ra	Radium
RA	Risk Assessment
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RL	reporting limit
RM	Removal Manager

LIST OF ACRONYMS

RML	Removal Management Levels
RPD	relative percent difference
RSD	relative standard deviation
RSL	regional screening levels
SAP	Sampling and Analysis Plan
SAS	Special Analytical Services
SCDM	Superfund Chemical Data Matrix
SI	Site Inspection
SOP	Standard Operating Procedure
SRM	Standard Reference Material
SSDMP	Site-Specific Data Management Plan
SSL	soil screening level
START IV	Superfund Technical Assessment and Response Team 4
SVOC	Semi-volatile Organic Compounds
TAL	Target Analyte List
TBD	to-be-determined
TCL	Target Compound List
TDD	Technical Direction Document
TEM	transmission electron microscopy
TSA	Technical Systems Audit
UFP-QAPP	Uniform Federal Policy–Quality Assurance Project Plan
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
U.S. EPA	United States Environmental Protection Agency
USGS	United States Department of the Interior Geologic Survey
UST	underground storage tank
VOC	Volatile Organic Compounds
WAM	Work Assignment Manager
WESTON	Weston Solutions, Inc.
XRD	x-ray diffraction
XRF	X-Ray Fluorescence

EXECUTIVE SUMMARY

PROBLEM STATEMENT

The Gold King Mine site consists of a mine adit and waste rock piles in the Cement Creek watershed. The mine historically discharged low pH, metals-laden water at a flow rate of approximately 100 gallons per minute (gpm). The water flows through a concrete channel, through a Parshall flume, through a plastic conduit, over a steep waste rock pile, and either into the subsurface (low flow), or toward North Fork Cement Creek. A pond was constructed at the base of the waste rock pile to collect water during 2014 site activities. North Fork Cement Creek flows into Cement Creek, which discharges to the Animas River in Silverton, Colorado.

On August 5, 2015, approximately 1 million gallons of acidic metals-laden water was unexpectedly released from the Gold King Mine. The mine water flowed across the site and to Cement Creek and then to the Animas River in Silverton, Colorado. Historically, EPA and the State of Colorado Division of Mining Reclamation and Safety (DRMS) had been working to control the existing flow from the Gold King Mine along with similar discharge that was emanating from the nearby Red and Bonita mine site. The project team was setting up to incorporate the flow from the Gold King Mine into the ongoing treatment of the flow from the Red and Bonita Mine when water that had been dammed in the Gold King Mine behind a collapsed section of adit broke through rock and debris.

PROJECT GOAL - The goal of the study is to determine the impact of the release on downstream waters and water users.

PROJECT AREA - The study area includes the Gold King Mine site and downstream locations potentially impacted from the Gold King release including Cement Creek and the Animas River.

PROJECT TASKS - EPA has requested that START assist to:

a. Collect samples from areas potentially affected by the release, including surface water, sediment, groundwater, and/or soil

b. Provide GPS data for sampling locations

c. Provide georeferenced site photodocumentation

Introduction

This Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP) identifies the data collection activities and associated QA/QC measures specific to the mine water release that occurred on August 5, 2015 from the Gold King Mine site (the Site) located near Silverton, San Juan County, Colorado.

Sampling for this emergency response field mobilization related to the removal activities will consist of surface water and sediment sampling at specific locations downstream from the Red and Bonita Removal site and the Gold King Mine site (the Site(s) on the Cement Creek and Animas River. This SAP/QAPP has been prepared as part of the emergency response activities for the site(s). Any deviations or modifications to the approved SAP/QAPP will be documented using the Revision Log.

This SAP/QAPP is produced in accordance with the Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP). A QAPP is a formal document describing in comprehensive detail the necessary quality assurance (QA), quality control (QC), and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated performance criteria. A QAPP presents the steps that should be taken to ensure that environmental data collected are of the correct type and quality required for a specific decision or use. The UFP-QAPP is a consensus document prepared by the Intergovernmental Data Quality Task Force (IDQTF).

Addendums to this document will be issued if needed to address any new procedures required.

Project Organization and Team

Refer to the QAPP Worksheet 3 & 5, and 4, 7, & 8 for the program organizational chart, communication pathways, personnel responsibilities and qualifications, and special personnel training requirements. Project-specific information is provided below.

The following are key individuals identified for this project:

Name	Title/Role	Organization	Receive Copy of SAP?
Pete Stevenson	OSC	EPA	Y
Steve Way	OSC	EPA	Y
Hays Griswold	OSC	EPA	Y
Craig Myers	OSC	EPA	Y
John West	Project Team Lead	START	Y
Elliott Petri	Engineer	START	Y
Jan Christner	Principal Engineer	START	Y
Roy Weindorf	Senior Geoscientist	START	Y
David Robinson	Project Manager	START	Y

The program QA Manager and the Project Manager will maintain the approved SAP/QAPP on file. The PTL will distribute the most current copy of the project QA documents via electronic or hard copy, as directed by the OSC. Files for this project will be kept in accordance with Section H.20 of Contract No.: EP-S8-13-01, stating a length of 10 years from close of the project or end of litigation.

The following summarizes the relationship of the UFP-QAPP worksheets to the QA/G5 guidance.

Crosswalk: UFP-QAPP Workbook to 2106-G-05 QAPP

Optimized UFP-QAPP Worksheets		2106-G-05 QAPP Guidance Section	
A. Project Management and Objectives			
1 & 2	Title and Approval Page	2.2.1	Title, Version, and Approval/Sign-Off
3 & 5	Project Organization and QAPP Distribution	2.2.3	Distribution List
		2.2.4	Project Organization and Schedule
4, 7, & 8	Personnel Qualifications and Sign-Off Sheet	2.2.1	Title, Version, and Approval/Sign-Off
		2.2.7	Special Training Requirements and Certifications
6	Communication Pathways	2.2.4	Project Organization and Schedule
9	Project Planning Session Summary	2.2.5	Project Background, Overview, and Intended Use of Data
10	Conceptual Site Model (CSM)	2.2.5	Project Background, Overview, and Intended Use of Data
11	Project/Data Quality Objectives	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
12	Measurement Performance Criteria	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
13	Secondary Data Uses and Limitations	Chapter 3	QAPP ELEMENTS FOR EVALUATING EXISTING DATA
14 & 16	Project Tasks & Schedule	2.2.4	Project Organization and Schedule
15	Project Action Limits and Laboratory-Specific Detection/Quantitation Limits	2.2.6	Data/Project Quality Objectives and Measurement Performance Criteria
B. Measurement/Data Acquisition			
17	Sampling Design and Rationale	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
18	Sampling Locations and Methods	2.3.1	Sample Collection Procedure, Experimental Design, and Sampling Tasks
		2.3.2	Sampling Procedures and Requirements
19 & 30	Sample Containers, Preservation, and Hold Times	2.3.2	Sampling Procedures and Requirements
20	Field Quality Control (QC)	2.3.5	QC Requirements
21	Field Standard Operating Procedures (SOPs)	2.3.2	Sampling Procedures and Requirements
22	Field Equipment Calibration,	2.3.6	Instrument/Equipment Testing, Calibration

	Maintenance, Testing, and Inspection		and Maintenance Requirements, Supplies and Consumables
23	Analytical SOPs	2.3.4	Analytical Methods Requirements and Task Description
24	Analytical Instrument Calibration	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
25	Analytical Instrument and Equipment Maintenance, Testing, and Inspection	2.3.6	Instrument/Equipment Testing, Calibration and Maintenance Requirements, Supplies and Consumables
26 & 27	Sample Handling, Custody, and Disposal	2.3.3	Sample Handling, Custody Procedures, and Documentation
28	Analytical QC and Corrective Action	2.3.5	QC Requirements
29	Project Documents and Records	2.2.8	Document and Records Requirements
C. Assessment/Oversight			
31, 32, & 33	Assessments and Corrective Action	2.4	ASSESSMENTS AND DATA REVIEW (CHECK)
		2.5.5	Reports to Management
D. Data Review			
34	Data Verification and Validation Inputs	2.5.1	Data Verification and Validation Targets and Methods
35	Data Verification Procedures	2.5.1	Data Verification and Validation Targets and Methods
36	Data Validation Procedure	2.5.1	Data Verification and Validation Targets and Methods
37	Data Usability Assessment	2.5.2	Quantitative and Qualitative Evaluations of Usability
		2.5.3	Potential Limitations on Data Interpretation
		2.5.4	Reconciliation with Project Requirements

Worksheet 1 & 2 — Title and Approval Page

(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. **Project Identifying Information**

   a) **Site Name/Project Name:** Gold King Mine Blowout.
   b) **Site Location/Number:** Silverton, San Juan County, Colorado.
   c) **Contract/Work Assignment Number:** EP-S8-13-01/TDD 1508-04

2) **List Plans and reports from previous investigation relevant to this project.**
   Not applicable

Lead Investigative Organization's Program Manager: W. Scott Butterfield, CHMM/WESTON
Printed Name/Title

____
Signature/Date

Lead Investigative Organization's Project Manager: David Robinson/WESTON
Printed Name/Title

____
Signature/Date

Lead Investigative Organization's Delegated Quality Assurance Manager: Tana Jones/WESTON
Printed Name/Title

____
Signature/Date

Federal Regulatory Agency Contracting Officer's Representative: Maria Houston/EPA
Printed Name/Title

____
Signature/Date

Federal Regulatory Agency Work Assignment Manager: Peter Stevenson/EPA
Printed Name/Title

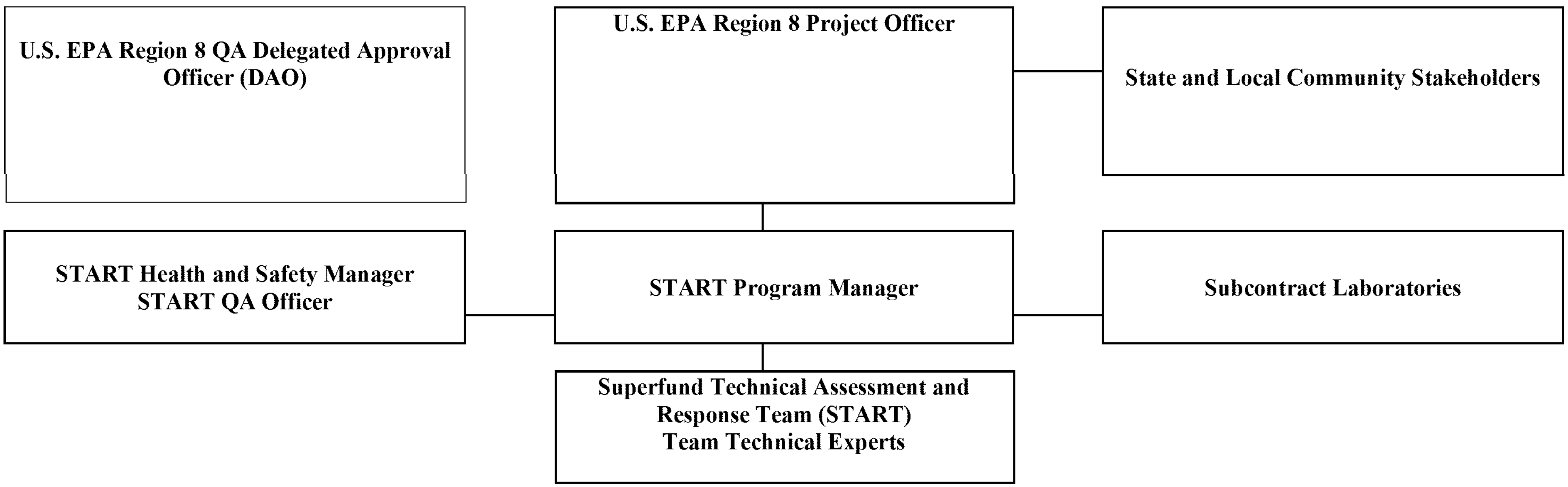
____
Signature/Date

Document Control Numbering System: W0267.1E.00531

Worksheet 3 & 5 — Project Organization and QAPP Distribution

(UFP-QAPP Manual Section 2.3 and 2.4)
(EPA 2106-G-05 Section 2.2.3 and 2.2.4)

The most current and approved copy of the QAPP will be delivered to recipients using a web-based system in use by EPA and START at the time of submittal.



Worksheet 4, 7 & 8 — Personnel Qualifications

(UFP-QAPP Manual Sections 2.3.2 - 2.3.4)
(EPA 2106-G-05 Section 2.2.1 and 2.2.7)

Name	Project Title / Role	Education / Experience	Specialized Training / Certifications[1]	Training Provider[2]
W. Scott Butterfield, CHMM	Program Manager / Point of contact (POC) with EPA CO, COR, and Team Leader. Ensures adherence to contract and project requirements/deliverables.	B.S., Environmental Science, M.S., Zoology/Estuarine Ecology / 32 years of diversified technical and program management experience on EPA Superfund contracts.	FEMA IS Levels 100, 200, 700, and 800, and EPA Hazard Ranking System, Documentation Record, Preliminary Assessment, Site Inspection, Air Monitoring, Emergency Response, Level A Team, and Multi-Media Sampling / Certified Hazardous Materials Manager (CHMM)	WESTON, Registered Training Organization – Various
David Robinson	PM / Operational POC for project level communications with EPA Removal Managers (RMs) and Emergency Response Managers (ERMs), ensure performance associated with the contract, coordinate and communicate with EPA in the pre-planning phase of individual Technical Direction Document (TDD) assignments, provide technical direction to the Project Team Lead (PTL), and support any functions delegated by the Program Manager.	B.S., Chemistry / Over 25 years' environmental experience, 7 years experience on Region 5 START contracts.	FEMA IS Levels 100, 200, 300, 400, 700, and 800; 32-Hour Advanced Radiation Training; Response Readiness Training; Biological Response Training; Nuclear, Biological, and Chemical Emergency Responders Training; 40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid and CPR	WESTON, Registered Training Organization – Various

Jan Christner, P.E.	Delegated QA Manager / Delegated authority for quality systems implementation and management, review and approval of quality documents, review and approval of contract deliverables, and performing quality assessments and quality systems audits. Maintains authority over implementation of quality systems management.	B.S., Chemical Engineering, M.S. Environmental Science and Engineering / Over 18 years of environmental experience including emergency response; planning and preparedness; removal assessments and actions; and remedial assessments, evaluations, and actions	Professional Engineer (P.E.); Nuclear, Biological, and Chemical Emergency Responders Training; 40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid and CPR	URS, WESTON, Registered Training Organization – Various
John West	PTL / Supervises field sampling and coordinates all field activities. Ensures all training/certifications are satisfied for field team personnel.	TBD	40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid and CPR	WESTON, Registered Training Organization – Various
Elliot Petri	Field Support / Assist with field sampling activities.	M.S., Environmental Science and Engineering / 3+ years of experience in the field of environmental sciences including Phase I/II ESAs, site investigations, assessments and remediation.	40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid and CPR.	WESTON, Registered Training Organization – Various
Roy Weindorf	Assistant PTL / Assists PTL and supervises field sampling and coordinates all field activities. Ensures all training/ certifications are satisfied for field team personnel.	B.S., Geology / Over 10 years of project experience including conducting site assessments, Phase I/II ESAs. FSs, etc.	40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; 30-Hour OSHA Field Supervisor Course; First Aid and CPR; P.G. in Texas	WESTON, Registered Training Organization – Various

Other field Technicians , Geologists, Environmental Scientists, Engineers as needed	TBD	TBD	40-Hour OSHA Hazardous Waste Site Worker Training; 8-Hour OSHA Refresher Training; First Aid and CPR	Registered Training Organization – Various

[1] Training records and/or certificates are on file at the Weston Solutions, Inc., West Chester, Pennsylvania office and are available upon request.

[2] Training provider and date of training will vary from person to person due to individual scheduling of training.

Worksheet 6 — Communication Pathways

(UFP-QAPP Manual Section 2.4.2)
(EPA 2106-G-05 Section 2.2.4)

Communication Drivers	Organization	Name	Contact Information	Procedures (Timing, Pathways, Documentation, etc.)
Regulatory Agency Interface	EPA CO	Maria Houston	303-312-7022	Maintain lines of communication between EPA Contracting Officer and WESTON Program Manager.
Approves Site-Specific QA Documents	EPA OSC/Task Monitor	TBD	TBD	Approves site-specific FSPs, SAPs, and/or QAPPs in accordance with EPA guidance documents and policy. Provides guidance or instruction for site-specific QA documents.
POC with EPA CO	WESTON Program Manager	W. Scott Butterfield, CHMM	303-729-6113	Maintain lines of communication between EPA CO, WAM/COR and Team Leader.
Manage all Project Phases	WESTON PM	David Robinson	937-572-3630	Manage day to day operations of the project. Reports to Program Manager and EPA WAM/COR issues with cost, schedule, etc.
Health and Safety Monitoring/Reporting	WESTON Health and Safety Manager	David Robinson	937-572-3630	Communicates with PTL and PM regarding safety issues/reporting on a daily basis, when required.
QAPP Changes Prior to Field Work and Field and Analytical Corrective Actions	WESTON Delegated QA Manager	Tana Jones.	720-232-4399	Communicates changes to Removal Action and Emergency Response QAPP to QA Officer and site-specific FSPs, SAPs, and/or QAPPs to PM and EPA WAM/COR. Communicates with PTL to determine need for field and analytical corrective actions.
QAPP Changes in the Field and Daily Field Progress Reports	WESTON PTL	John West,	303-729-6148	Communicate QAPP changes and field activities to Delegated QA Manager, EPA WAM/COR, and PM on a daily basis, when required.
QAPP Amendments	WESTON QA Officer	Cecilia H. Shappee, P.E.	713-985-6701	Major changes to the Removal Action and Emergency Response QAPP must be approved by the QA Officer and Delegated QA Manager before implementation.
Data Tracking and Management, Release of Analytical Data	WESTON Data Manager	John Lucotch	970-301-1416	The need for corrective actions will be determined by the Delegated QA Manager upon review of the data. No analytical data will be released prior to validation and all releases must be approved by the Delegated QA Manager and EPA WAM/COR.

Communication Drivers	Organization	Name	Contact Information	Procedures (Timing, Pathways, Documentation, etc.)
Lab Data Quality Issues	Laboratory PM	TBD	TBD	Laboratory PM will report any issues with project samples to the Delegated QA Manager within 2 business days.

Worksheet 9 — Project Planning Session Summary

(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

Date: 8/7/15

Location: Email – OSC Joyce Ackerman to START Program Manager Scott Butterfield

Purpose: Identification of sampling needs for Gold King Mine release assessment

Notes/Comments: OSC Joyce Ackerman sent email to START that identified needs for sampling based on public meeting that OSC Pete Stevenson attended. START followed up with brief phone call with OSC Stevenson confirming that START will prepare the Sampling and Analysis Plan (SAP). The following are the anticipated sampling needs:

- Water quality samples with field parameters and at drinking water intakes
- Residential wells along the river on request
- Water in irrigation ditches that were impacted
- River sediments
- Sediment in irrigation ditches
- Soil samples from irrigated land
- Also consider long term monitoring methods

Consensus Decisions Made:

- START to prepare SAP

Action Items:

Action	Responsible Party	Due Date
Prepare site-specific SAP	START	8/9/15

Worksheet 10 — Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)

- **Problem Definition**

The Gold King Mine site consists of a mine adit and waste rock piles in the Cement Creek watershed. The mine historically discharged low pH, metals-laden water at a flow rate of approximately 100 gallons per minute (gpm). The water flows through a concrete channel, through a Parshall flume, through a plastic conduit, over a steep waste rock pile, and either into the subsurface (low flow), or toward North Fork Cement Creek. A pond was constructed at the base of the waste rock pile to collect water during 2014 site activities. North Fork Cement Creek flows into Cement Creek, which discharges to the Animas River in Silverton, Colorado.

On August 5, 2015, approximately 1 million gallons of acidic metals-laden water was unexpectedly released from the Gold King Mine. The mine water flowed across the site and to Cement Creek and then to the Animas River in Silverton, Colorado. Historically, EPA and the State of Colorado Division of Mining Reclamation and Safety (DRMS) had been working to control the existing flow from the Gold King Mine along with similar discharge that was emanating from the nearby Red and Bonita mine site. The project team was setting up to incorporate the flow from the Gold King Mine into the ongoing treatment of the flow from the Red and Bonita Mine when water that had been dammed in the Gold King Mine behind a collapsed section of adit broke through rock and debris.

- **Background Information/Site History**

The Red and Bonita Mine and the Gold King Mine are in the Cement Creek watershed, which originates high in the rugged San Juan Mountains of southwestern Colorado near the San Juan County and Ouray County line on the south slopes of Red Mountain Number 3 and the north slopes of Storm Peak.

The rugged and relatively inaccessible western San Juan Mountains were first prospected in the area around Silverton in 1860. The extension of the railroad from Silverton up Cement Creek to Gladstone in 1899 encouraged the mining of low grade ores, and the establishment of a lead-zinc flotation plant in 1917 allowed for the treatment of the low grade complex ores found in the area. Over a 100-year period between 1890 and 1991, mining activities in the upper Animas River Basin, including Cement Creek, produced the waste rock and mill tailings sources from which contamination spread throughout the surface water pathway. Over 18 million tons of ore were mined from the Upper Animas River Basin area, with more than 95 percent of this being dumped directly into the Animas River and its tributaries in the form of mill waste. Older waste rock piles and stope fillings were reworked and sent to mills as technology allowed lower grade ores to be processed economically. A great deal of abandoned waste was also milled during World War II when many older mining and milling structures were cannibalized for scrap metal. The last producing mine in the area was the Sunnyside Mine, which ceased production in 1991. The closing of the Sunnyside mine occurred after Lake Emma drained into the mine and out the American Tunnel into Cement Creek in 1978. The flood water from the Lake Emma "blow-out" was reported to have flowed down Cement Creek in a 10-foot wall of water that would have transported a large quantity of tailing and other mine waste down Cement Creek to the Animas River.

Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River. The confluence of Cement Creek and the Animas River is located approximately eight miles downstream of Gladstone.

The Animas River Stakeholders Group (ARSG), U.S. Bureau of Land Management (BLM), DRMS, EPA, and private stakeholders have participated in various projects to manage mine waste and to reduce the flow of contaminated water in the watershed. In addition, under the terms of a consent decree with the State of Colorado, Sunnyside Gold Mine Company performed several large scale projects related to historic operations on properties associated with the company's operations. One project was plugging (installing concrete bulkheads) within the Sunnyside mine workings, including the American Tunnel, during the period from 1996 to 2002. The American Tunnel is located in Gladstone, approximately ¾ to 1 mile south of the Red and Bonita and Gold King mines. During the mine operation, the American Tunnel discharged approximately 1,700 gpm of metal laden water and was treated prior discharging to Cement Creek. Following the installation of the last of the three plugs, flow from the American Tunnel has decreased to approximately 100 gpm, the result of leakage around the concrete bulkhead. The flow from the Red and Bonita Mine, the Gold King (Level 7) Mine, and the Mogul Mine all experienced significant increases in flow following the plugging of the American Tunnel.

Contaminants found in the Red and Bonita discharge water include low pH and metals. Cadmium concentrations from the mine discharge ranged from 33.3 micrograms per liter (µg/L) to 39.3 µg/L, copper concentrations ranged from 4.5 µg/L to 50.6 µg/L, iron concentrations range from 76,700 µg/L to 97,600 µg/L, lead concentrations ranged from 34 µg/L to 71.2 µg/L, and zinc concentrations ranged from 13,600 µg/L to 17,500 µg/L.

Contaminants in the Gold King discharge water include low pH and metals. From 2009 to 2011, cadmium concentrations from the mine discharge ranged from 38 micrograms per liter (µg/L) to 136 µg/L, copper concentrations ranged from 2400 µg/L to 12,000 µg/L, lead concentrations ranged from 2 µg/L to 29 µg/L, and zinc concentrations ranged from 14,500 µg/L to 44,700 µg/L.

Background Reference:

- URS Operating Services, Inc. 2010. Red and Bonita Mine Remedial Action Field Sampling Plan. October 2010.
- Weston Solutions Inc., 2014. Sampling and Analysis Plan for Red and Bonita Mine. Nov 2014.

Worksheet 11 — Project/Data Quality Objectives

(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

Data quality objectives are based on the following seven steps.

State the Problem

On August 5, 2015, approximately 1 million gallons of acidic metals-laden water and sludge was unexpectedly released from the Gold King Mine. The mine water flowed across the site and to Cement Creek and then to the Animas River in Silverton, Colorado.

EPA has requested that START assist to:

a. Collect samples from areas potentially affected by the release, including surface water, sediment, groundwater, and/or soil

b. Provide GPS data for sampling locations

c. Provide georeferenced site photodocumentation

Identify the Goals of the Study

The goals of the study are to:

- Determine the impact of the release on downstream waters and water users.

The primary study questions are:

- What areas were affected by the release from Gold King Mine?
- What are the water quality conditions, as indicated by field and laboratory analyses, in Cement Creek and the Animas River?
- Based on laboratory analyses, are other media such as sediment, soil or groundwater affected by the mine water release?

Identify Information Inputs

To support the above objectives, the following data will be collected:

- Surface water and sediment samples will be collected and analyzed for metals. If needed, groundwater and soil may also be sampled.
- Field measurements of surface water and/or groundwater quality.
- Geospatial data of sampling locations.
- Field documentation and photographs of site activities.

Define the Boundaries of the Study

Spatial Boundaries: The study area includes the Gold King Mine site and downstream locations potentially impacted from the Gold King release.

Temporal Boundaries: The study will represent conditions from after the release from the Gold King Mine and ending at an as yet undetermined date. A sampling schedule and sampling plan is included in Worksheets 14, 16 and 17.

Practical constraints on data collection: Scheduling adjustments will be made if physical constraints on planned field events occur due to weather, safety considerations, or problems that may impact the technical quality of the measurements.

Develop the Analytic Approach

Samples will be collected from locations designated in the field by an EPA OSC. Samples will be sent for laboratory analysis of total and dissolved TAL metals and other parameters as directed by the OSC.

The results may be compared to WQS for Animas River Stream Segment 3b (Animas River) or 7 (Cement Creek), Maximum Contaminant Levels (MCLs), and/or other benchmarks as directed by the EPA OSC.

Specify Performance or Acceptance Criteria

All data will be reviewed and verified to ensure that they are acceptable for the intended use. Data will be validated at the request of the EPA OSC.

Decision errors will be limited to the extent practicable by following approved U.S. EPA methods and applicable SOPs listed in Worksheet #21. Any deviation from the SAP will be documented.

Develop the Detailed Plan for Obtaining Data

Water, sediment, and soil samples will be collected at locations designated by the EPA OSC. Worksheets 17, 18, 20, and 21 present the sampling design and procedures.

Field water quality parameters will be obtained using a Horiba (U50 or U53) or similar water quality meter. Field monitoring will be used to measure the quality of water, with emphasis on pH measurements. Visual observations of water clarity will be recorded.

Worksheets 19, 20, 24-28 and 30 specify analytical requirements. Data from the laboratories will be delivered in an electronic data deliverable and reported in the site activities report. A site-specific Data Management Plan is provided in Appendix B.

Worksheet 12 — Measurement Performance Criteria Tables

(UFP-QAPP Manual Section 2.6.2)
(EPA 2106-G-05 Section 2.2.6)

The following are typical examples for Inorganics for all media.

Matrix: All
Analytical Group or Method: Inorganics
Concentration Level: All

DQI	QC Sample or Measurement Performance Activity	MPC
Field Precision	Field Duplicate	1 per 10 samples RPD determined on a sampling method-specific basis
Field Representativeness/ Accuracy/Bias	Equipment Rinsate Blank	1 per 20 samples/matrix or 1 per day <½ LOQ
Accuracy/Bias	MS/MSD	1 per 20 samples per matrix RPD <20%
Laboratory Precision	Laboratory Duplicate	1 per 20 samples per matrix RPD <20%
Accuracy/Precision	Initial Calibration	Daily prior to sample analysis (minimum 1 standard and a blank)
Accuracy/Bias	Initial Calibration Verification	Daily after initial calibration All analytes within ±10% of expected value
Accuracy/Bias	Calibration Blank (CB) Initial Calibration Blank/Continuing Calibration Blank (ICB/CCB)	After every calibration/verification No analytes detected ≥ Limit of Detection (LOD)
Precision/Accuracy	Calibration Verification (Instrument Check Standard)	At beginning of analytical sequence, after every 10 samples and at the end of the analysis sequence All analytes within ±10% of expected value and RSD of replicate integrations <5%
Precision	Interference Check Solution	At beginning of analytical run ± 20% of the expected value
Precision/Accuracy	Serial Dilution	Method-specific
Accuracy/Bias	Post Digestion Blank	Each digestion batch %R. Analyte-specific
Laboratory Representativeness/ Accuracy/Bias	Method Blank	1 per batch per matrix or 1 per 20 samples, whichever is more frequent No analyte ≥ RL
Laboratory Accuracy/ Sensitivity	LCS	1 per batch per matrix or 1 per 20 samples, whichever is more frequent No analyte ≥ LOQ

Worksheet 13 — Secondary Data Uses and Limitations

(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

Sources and types of secondary data include but are not limited to the following:

Data Type	Data Source (originating organization, report title and date)	Data Uses Relative to Current Project	Factors Affecting the Reliability of Data and Limitations on Data Use
Soils	United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) Web Soil Survey and Soil Data Mart	Identify soil types, composition, elevation, precipitation, setting, properties and qualities, profile, land capability and farmland classification	
Geology/Hydrolog y	United States Department of the Interior Geologic Survey (USGS) Topographic and Geologic Maps, State Agencies/EPA My WATERS Mapper	Identify area Geology, topography, surface water bodies, hydrologic units/watersheds, water quality, etc.	
Streams/Drainages	EPA My WATERS Mapper and USGS Topographic Maps	Topography, surface water bodies, hydrologic units/watersheds, water quality, etc.	
Registered Wells	State Databases	Identify well locations, drinking water wells, and groundwater use	
Meteorological	National Weather Service	Seasonal fluctuations in storm water runoff	
Property Boundaries	County Assessor and Plat Maps	Identify property boundaries to determine site requirements for assessment	
Environmentally Sensitive Areas	U.S. and State Fish & Wildlife Service Maps, Publications, and Databases	Identify sensitive and endangered species and environments potentially present on or in removal action/emergency response area	
Wetlands	USDA NRCS Web Soil Survey and Soil Data Mart (Hydric Soils List), and U.S. and State Fish & Wildlife Databases	Identify wetlands and associated sensitive and endangered species and environments potentially present on or in removal action/emergency response area	
Historical and Current Site Use and Investigations	Historical Records, Previous Investigations, Visual Site Reconnaissance, and Interviews	Supplemental background information on historical site use and current site conditions, and previous investigations	

The project team will carefully evaluate the quality of secondary data (in terms of precision, bias, representativeness, comparability, and completeness) to ensure they are of the type and quality necessary to support their intended uses. When evaluating the reliability of secondary data and determining limitations on their uses, the project team will consider the source of the data, the time period

Worksheet 13 — Secondary Data Uses and Limitations (Continued)

(UFP-QAPP Manual Section 2.7)
(EPA 2106-G-05 Chapter 3: QAPP Elements for Evaluating Existing Data)

during which they were collected, data collection methods, potential sources of uncertainty, the type of supporting documentation available, and the comparability of data collection methods to the currently proposed methods. With respect to secondary analytical data that will be utilized to support critical decisions, such as comparison of contaminant levels with applicable standards, a detailed review of the data will be necessary to determine the usability of the data. In addition to the qualitative rating of the data source, the project team should complete a data quality review and document the review in a data usability summary. The protocol for completing the data usability report is provided in Worksheet 37.

In accordance with EPA guidance documents *A Summary of General Assessment Factors for Evaluating the Quality of Scientific and Technical Information* (June 2003) and *Guidance for Evaluating and Documenting the Quality of Existing Scientific and Technical Information* (December 2012) (Appendix Q), the following assessment factors will be utilized to assess the quality and relevance of scientific and technical information:

1. **Soundness** – the extent to which the scientific and technical procedures, measures, methods or models employed to generate the information are reasonable for, and consistent with, the intended application.
2. **Applicability and Utility** – the extent to which the information is relevant for the Agency's intended use.
3. **Clarity and Completeness** – the degree of clarity and completeness with which the data, assumptions, methods, quality assurance, sponsoring organizations and analyses employed to generate the information are documented.
4. **Uncertainty and Variability** – the extent to which the variability and uncertainty (quantitative and qualitative) in the information or in the procedures, measures, methods or models are evaluated and characterized.
5. **Evaluation and Review** – the extent of independent verification, validation and peer review of the information or of the procedures, measures, methods or models.

The type of information, sources of information and quantity of information will be project-specific. The following table can be utilized and/or modified as appropriate in the development of the site-specific FSP, SAP and/or QAPP and site report to capture the review of the secondary data assessment factors. Assessment factors will be rated as Acceptable, Marginal, Unacceptable, Not Applicable, or Indeterminate.

Citation	Reference Type	Soundness	Applicability and Utility	Clarity and Completeness	Uncertainty and Variability	Evaluation and Review

Worksheet 14 & 16 —Project Tasks & Schedule

(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Project Initiation	EPA/START	August 6, 2015	August 6, 2015	N/A	N/A
Develop a SAP for Removal and Emergency Response Activities and the EPA Region 8 QA Document Review Crosswalk	START	August 7, 2015	August 8, 2015	Develop a SAP for Removal and Emergency Response Activities and the EPA Region 8 QA Document Review Crosswalk	August 9, 2015
Develop Health and Safety Plan (HASP)	START	August 6, 2015	August 6, 2015	HASP	August 6, 2015
Mobilization/Demobilization	START	August 6, 2015	August 6, 2015	Field Notes	N/A
Sample Collection Tasks	START	August 6, 2015	TBD	Field Notes	TBD
Analytical Tasks	START/ Laboratory	August 6, 2015	TBD	Field Notes/Laboratory Reports	TBD
Quality Control Tasks	START	August 6, 2015	TBD	Report of Analyses/Data Package	TBD
Validation	START	August 6, 2015	TBD	Validation Summary Report	TBD

Summarize Data	START	August 6, 2015	TBD	Daily Update	TBD

Worksheet 15 — Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

(UFP-QAPP Manual Sections 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

The following information provides representative benchmarks that may be useful for comparison of analytical sample results. Due to the ongoing nature of the project, multiple benchmarks may be appropriate for comparison. Benchmarks utilized for data analysis and reporting will be documented within each report. The examples below are for water samples collected from residential taps based on EPA screening levels and for surface water samples based on Colorado water quality standards. Multiple laboratories may be utilized. Quantitation and detection limits may vary between laboratories based on localized equipment.

Matrix: Water
Analytical Method: 200.7, 200.8, 245.1
Concentration level (if applicable): Low to High

Analyte	EPA Tapwater (µg/L)	PAL Reference[1]	Project Quantitation Limit (PQL) Goal	Laboratory Quantitation Limit (LQL)[2, 3]	Laboratory Detection Limit (LDL)[2, 3]
Total Metals					
Aluminum	20000	EPA RSL Table	TBD	TBD	TBD
Antimony	7.8	EPA RSL Table	TBD	TBD	TBD
Arsenic	0.052	EPA RSL Table	TBD	TBD	TBD
Barium	3800	EPA RSL Table	TBD	TBD	TBD
Beryllium	25	EPA RSL Table	TBD	TBD	TBD
Cadmium	9.2	EPA RSL Table	TBD	TBD	TBD
Calcium	NE	EPA RSL Table	TBD	TBD	TBD
Chromium	NE	EPA RSL Table	TBD	TBD	TBD
Cobalt	6	EPA RSL Table	TBD	TBD	TBD
Copper	800	EPA RSL Table	TBD	TBD	TBD
Iron	14000	EPA RSL Table	TBD	TBD	TBD
Lead	15	EPA RSL Table	TBD	TBD	TBD
Magnesium	NE	EPA RSL Table	TBD	TBD	TBD
Manganese	430	EPA RSL Table	TBD	TBD	TBD
Mercury	0.63	EPA RSL Table	TBD	TBD	TBD
Molybdenum	100	EPA RSL Table	TBD	TBD	TBD

Nickel	NE	EPA RSL Table	TBD	TBD	TBD
Potassium	390	EPA RSL Table	TBD	TBD	TBD
Selenium	100	EPA RSL Table	TBD	TBD	TBD
Silver	94	EPA RSL Table	TBD	TBD	TBD
Sodium	NE	EPA RSL Table	TBD	TBD	TBD
Thallium	0.2	EPA RSL Table	TBD	TBD	TBD
Vanadium	86	EPA RSL Table	TBD	TBD	TBD
Zinc	6000	EPA RSL Table	TBD	TBD	TBD
Dissolved Metals					
Aluminum	NE	EPA RSL Table	TBD	TBD	TBD
Antimony	NE	EPA RSL Table	TBD	TBD	TBD
Arsenic	NE	EPA RSL Table	TBD	TBD	TBD
Barium	NE	EPA RSL Table	TBD	TBD	TBD
Beryllium	NE	EPA RSL Table	TBD	TBD	TBD
Cadmium	NE	EPA RSL Table	TBD	TBD	TBD
Calcium	NE	EPA RSL Table	TBD	TBD	TBD
Chromium	NE	EPA RSL Table	TBD	TBD	TBD
Cobalt	NE	EPA RSL Table	TBD	TBD	TBD
Copper	NE	EPA RSL Table	TBD	TBD	TBD
Iron	NE	EPA RSL Table	TBD	TBD	TBD
Lead	NE	EPA RSL Table	TBD	TBD	TBD
Magnesium	NE	EPA RSL Table	TBD	TBD	TBD
Manganese	NE	EPA RSL Table	TBD	TBD	TBD
Mercury	NE	EPA RSL Table	TBD	TBD	TBD
Nickel	NE	EPA RSL Table	TBD	TBD	TBD
Potassium	NE	EPA RSL Table	TBD	TBD	TBD
Selenium	NE	EPA RSL Table	TBD	TBD	TBD
Silver	NE	EPA RSL Table	TBD	TBD	TBD
Sodium	NE	EPA RSL Table	TBD	TBD	TBD
Thallium	NE	EPA RSL Table	TBD	TBD	TBD
Vanadium	NE	EPA RSL Table	TBD	TBD	TBD
Zinc	NE	EPA RSL Table	TBD	TBD	TBD

[1] EPA RSLs are screening levels used to consider whether additional assessment is needed

[2,3] Terminology is project/laboratory-specific.

Colorado Water Quality Standards

TABLE III METAL PARAMETERS (Concentration in ug/l)						
METAL[1]	AQUATIC LIFE[1][3][4][J]		AGRICULTURE[2]	DOMESTIC WATER-SUPPLY[2]	WATER + FISH[7]	FISH INGESTION[10]
	ACUTE	CHRONIC				
Aluminum	$e^{(1.3695[\ln(hardness)]+1.8308)}$ (tot.rec.)	87 or $e^{(1.3695[\ln(hardness)]-0.1158}$ (tot.rec.)[11]			---	---
Antimony				6.0 (30-day)	5.6	640
Arsenic	340	150	100[A] (30-day)	0.02 – 10[13] (30-day)[14]	0.02	7.6
Barium				1,000[E] (1-day) 490 (30-day)	---	---
Beryllium			100[A,B] (30-day)	4.0 (30-day)	---	---
Cadmium	$(1.136672-[\ln(hardness) \times (0.041838)])\times e^{0.9151[\ln(hardness)]-3.1485}$ (Trout)=$(1.136672-[\ln(hardness)\times (0.041838)])\times e^{0.9151[\ln(hardness)]-3.6236}$	$(1.101672-[\ln(hardness)\ \times(0.041838)] \times e^{0.7998[\ln(hardness)]-4.4451}$	10[B] (30-day)	5.0[E] (1-day)	---	---
Chromium III[5]	$e^{(0.819[\ln(hardness)]+2.5736)}$	$e^{(0.819[\ln(hardness)]+0.5340)}$	100[B] (30-day)	50[E] (1-day)	---	---
Chromium VI[5]	16	11	100[B] (30-day)	50[E] (1-day)	100(30-day)	---
Copper	$e^{(0.9422[\ln(hardness)]-1.7408)}$	$e^{(0.8545[\ln(hardness)]-1.7428)}$	200[B]	1,000[F] (30-day)	1,300	---
Iron		1,000(tot.rec.)[A,C]		300(dis)[F] (30-day)	---	---
Lead	$(1.46203-[(\ln(hardness)^{*}(0.145712)])^{*}e^{(1.273[\ln(hardness)]-1.46)}$	$(1.46203-[(\ln(hardness)^{*}(0.145712)])^{*}e^{(1.273[\ln(hardness)]-4.705)}$	100[B] (30-day)	50[E] (1-day)	—	---
Manganese	$e^{(0.3331[\ln(hardness)]+6.4676)}$	$e^{(0.3331[\ln(hardness)]+5.8743)}$	200[B] (30-day)[12]	50(dis)[F] (30-day)	—	---
Mercury		FRV(fish)[6] = 0.01 (Total)		2.0[E] (1-day)	—	---
Molybdenum			300[O] (30-day)[16]	210 (30-day)		

TABLE III METAL PARAMETERS (Concentration in ug/l)						
METAL(1)	AQUATIC LIFE(1)(3)(4)(J)		AGRICULTURE(2)	DOMESTIC WATER-SUPPLY(2)	WATER + FISH(7)	FISH INGESTION(10)
	ACUTE	CHRONIC				
Nickel	$e^{(0.846[\ln(hardness)]+2.253)}$	$e^{(0.846[\ln(hardness)]+0.0554)}$	200(B) (30-day)	100(E) (30-day)	610	4,600
Selenium(9)	18.4	4.6	20(B,D) (30-day)	50(E) (30-day)	170	4,200
Silver	$\frac{1}{2}e^{(1.72[\ln(hardness)]-6.52)}$	$e^{(1.72[\ln(hardness)]-9.06)}$ (Trout) = $e^{(1.72[\ln(hardness)]-10.51)}$		100(F) (1-day)	—	---
Thallium		15(C)		0.5 (30-day)	0.24	0.47
Uranium(17)	$e^{(1.1021[\ln(hardness)]+2.7088)}$	$e^{(1.1021[\ln(hardness)]+2.2382)}$		16.8 – 30(13) (30-day)	---	---
Zinc	$0.978*e^{(0.9094[\ln(hardness)]+0.9095)}$	$0.986*e^{(0.9094[\ln(hardness)]+0.6235)}$ (sculpin)(15) = $e^{(2.140[\ln(hardness)]-5.084)}$	2000(B) (30-day)	5,000(F) (30-day)	7,400	26,000
NOTE: Capital letters in parentheses refer to references listed in section 31.16(3); Numbers in parentheses refer to Table III footnote						

CDPHE Colorado Department of Public Health and Environment
Hardness dependent dissolved water quality standards will be calculated using the mean value of all samples in the applicable stretch of stream.

Table III – Footnotes

(1) Metals for aquatic life use are stated as dissolved unless otherwise specified.

Where the hardness-based equations in Table III are applied as table value water quality standards for individual water segments, those equations define the applicable numerical standards. As an aid to persons using this regulation, Table IV provides illustrative examples of approximate metals values associated with a range of hardness levels. This table is provided for informational purposes only.

(2) Metals for agricultural and domestic uses are stated as total recoverable unless otherwise specified.

(3) Hardness values to be used in equations are in mg/l as calcium carbonate and shall be no greater than 400 mg/l. The exception is for Al, where the upper cap on calculations is a hardness of 220 mg/l. For permit effluent limit calculations, the hardness values used in calculating the appropriate metal standard should be based on the lower 95 per cent confidence limit of the mean hardness value at the periodic low flow criteria as determined from a regression analysis of site-specific data. Where insufficient site-specific data exists to define the mean hardness value at the periodic low flow criteria, representative regional data shall be used to perform the regression analysis. Where a regression analysis is not possible, a site-specific method should be used, e.g., where hardness data exists without paired flow data, the mean of the hardness during the low flow season established in the permit shall be used. In calculating a hardness value, regression analyses should not be extrapolated past the point that data exist. For determination of standards attainment, where paired metal/hardness data is available, attainment will be determined for individual sampling events. Where paired data is not available, the mean hardness will be used.

(4) Both acute and chronic numbers adopted as stream standards are levels not to be exceeded more than once every three years on the average.

(5) Unless the stability of the chromium valence state in receiving waters can be clearly demonstrated, the standard for chromium should be in terms of chromium VI. In no case can the sum of the instream levels of Hexavalent and Trivalent Chromium exceed the water supply standard of 50ug/l total chromium in those waters classified for domestic water use.

(6) FRV means Final Residue Value and should be expressed as "Total" because many forms of mercury are readily converted to toxic forms under natural conditions. The FRV value of 0.01 ug/liter is the maximum allowed concentration of total mercury in the water that will present bioconcentration or bioaccumulation of methylmercury in edible fish tissue at the U.S. Food and Drug Administration's (FDA) action level of 1 ppm. The FDA action level is intended to protect the average consumer of commercial fish; it is not stratified for sensitive populations who may regularly eat fish.

A 1990 health risk assessment conducted by the Colorado Department of Public Health and Environment indicates that when sensitive subpopulations are considered, methylmercury levels, in sport-caught fish as much as one-fifth lower (0.2 ppm) than the FDA level may pose a health risk.

In waters supporting populations of fish or shellfish with a potential for human consumption, the Commission can adopt the FRV as the stream standard to be applied as a 30-day average. Alternatively, the Commission can adopt site-specific ambient based standards for mercury in accordance with section 31.7(1)(b)(ii) and (iii). When this option is selected by a proponent for a particular segment, information must be presented that (1) ambient water concentrations of total mercury are detectable and exceed the FRV, (2) that there are detectable levels of mercury in the proponent's discharge and that are contributing to the ambient levels and (3) that concentrations of methylmercury in the fish exposed to these ambient levels do not exceed the maximum levels suggested in the CDH Health Advisory for sensitive populations of humans. Alternatively or in addition the proponent may submit information showing that human consumption of fish from the particular segment is not occurring at a level which poses a risk to the general population and/or sensitive populations.

(7) Applicable to all Class 1 aquatic life segments which also have a water supply classification or Class 2 aquatic life segments which also have a water supply classification designated by the Commission after rulemaking hearing. These Class 2 segments will generally be those where fish of a catchable size and which are normally consumed are present, and where there is evidence that fishing takes place on a recurring basis. The Commission may also consider additional evidence that may be relevant to a determination whether the conditions applicable to a particular segment are similar enough to the assumptions underlying the water plus fish ingestion criteria to warrant the adoption of water plus fish ingestion standards for the segment in question.

(8) The use of 0.1 micron pore size filtration for determining dissolved iron is allowed as an option in assessing compliance with the drinking water standard.

(9) Selenium is a bioaccumulative metal and subject to a range of toxicity values depending upon numerous site-specific variables.

(10) Applicable to the following segments which do not have a water supply classification: all Class 1 aquatic life segments or Class 2 aquatic life segments designated by the Commission after rulemaking hearing. These class 2 segments will generally be those where fish of a catchable size and which are normally consumed are present, and where there is evidence that fishing takes place on a recurring basis. The Commission may also consider additional evidence that may be relevant to a determination whether the conditions applicable to a particular segment are similar enough to the assumptions underlying the fish ingestion criteria to warrant the adoption of fish ingestion standards for the segment in question.

(11) Where the pH is equal to or greater than 7.0 in the receiving water after mixing, the chronic hardness-dependent equation will apply. Where pH is less than 7.0 in the receiving water after mixing, either the 87 µg/l chronic total recoverable aluminum criterion or the criterion resulting from the chronic hardness-dependent equation will apply, whichever is more stringent.

(12) This standard is only appropriate where irrigation water is applied to soils with pH values lower than 6.0.

(13) Whenever a range of standards is listed and referenced to this footnote, the first number in the range is a strictly health-based value, based on the Commission's established methodology for human health-based standards. The second number in the range is a maximum contaminant level, established under the federal Safe Drinking Water Act that has been determined to be an acceptable level of this chemical in public water supplies, taking treatability and laboratory detection limits into account. Control requirements, such as discharge permit effluent limitations, shall be established using the first number in the range as the ambient water quality target, provided that no effluent limitation shall require an "end-of-pipe" discharge level more restrictive than the second number in the range. Water bodies will be considered in attainment of this standard, and not included on the Section 303(d) List, so long as the existing ambient quality does not exceed the second number in the range.

(14) The arsenic limit shall be calculated to meet the relevant standard in accordance with the provisions of Section 31.10 of this regulation unless:

a. The permittee provides documentation that a reasonable level of inquiry demonstrates that there is no actual domestic water supply use of the waters in question or of hydrologically connected ground water, or

b. The arsenic concentration at the point of intake to the domestic water supply will not exceed the standard as demonstrated through modeling or other scientifically supportable analysis.

(15) The chronic zinc equation for sculpin applies in areas where mottled sculpin are expected to occur and hardness is less than 102 ppm $CaCO_3$. The regular chronic zinc equation applies in areas where mottled sculpin are expected to occur, but the hardness is greater than 102 ppm $CaCO_3$.

(16) In determining whether adoption of a molybdenum standard is appropriate for a segment, the Commission will consider whether livestock or irrigated forage is present or expected to be present. The table value assumes that copper and molybdenum concentrations in forage are 7 mg/kg and 0.5 mg/kg respectively, forage intake is 6.8 kg/day, copper concentration in water is 0.008 mg/l, water intake is 54.6 l/day, copper supplementation is 48 mg/day, and that a Cu:Mo ratio of 4:1 is appropriate with a 0.075 mg/l molybdenum margin of safety. Numeric standards different than the table-value may be adopted on a site-specific basis where appropriate justification is presented to the Commission. In evaluating site-specific standards, the relevant factors that should be considered include the presence of livestock or irrigated forage, and the total intake of copper, molybdenum, and sulfur from all sources (i.e., food, water, and dietary supplements). In general, site-specific standards should be based on achieving a safe copper:molybdenum total exposure ratio, with due consideration given to the sulfur exposure. A higher Cu:Mo ratio may be necessary where livestock exposure to sulfur is also high. Species specific information shall be considered where cattle are not the most sensitive species.

(17) When applying the table value standards for uranium to individual segments, the Commission shall consider the need to maintain radioactive materials at the lowest practical level as required by Section 31.11(2) of the Basic Standards regulation.

Worksheet 17 — Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

START will collect surface water samples to characterize water quality and flow impacts from the Gold King Mine release. Surface water will be monitored periodically for pH. Other water quality parameters such as conductivity, turbidity and dissolved oxygen will be measured as long as the additional information is helpful in evaluating site conditions.

Additional media such as sediment, soil and/or groundwater may also be sampled, as directed by the EPA OSC.

This project involves the collection of laboratory samples and field screening data (Worksheet 18 and Table 1). Sample points will be located with a Global Positioning System (GPS) device to be used for mapping purposes and to document sample locations selected in the field. If sampling locations become inaccessible, alternate sampling locations which provide similarly adequate or sufficient data as the original will be identified and sampled based upon the best judgment of the inspector/sampler, if necessary.

Sample Locations and Nomenclature

Sample locations will be identified in the field in coordination with the EPA OSC. In general, the sampling area extends from the Gold King Mine along Cement Creek and then along the Animas River to the New Mexico border. The priority and importance of each sample will be determined by the OSC.

Sample identification will utilize the following nomenclature, unless a previously defined station named exists, in which case the previously defined identification will be utilized. Sample nomenclature will use the following to designate the project: Gold King Mine (GKM) followed by indication of the sample matrix, a sequential sample number, and the date (MMDDYY). Sample matrix identifiers are:

- SW – surface water
- SD – sediment
- GW – groundwater
- TW - tapwater
- SO – soil
- MC—macroinvertebrates

If needed, additional identifiers to distinguish other media types may be added. These will be noted by the sampler in the field logbook.

For example, GKMSW04-080915 would designate the surface water sample collected on 8/9/15 from the fourth location. Samples will be recorded in a logbook and GPS coordinates recorded. If site conditions warrant the modification of nomenclature, this change will be documented in the logbook.

Previously identified locations that may be sampled are listed below.

Sample ID	Sample Location Description	Latitude / Longitude
CC01C	Grand Mogul adit. Sample water from the toe of the waste pile.	37 54 35.72 N 107 37 51.66 W
CC02D	Mogul Mine adit. Sample water downstream of mine pool at the 3 inch flume.	37 54 36.14 N 107 38 17.26 W
CC03D	Red & Bonita mine adit. Sample water at the culvert crossing under the road.	37 53 48.46 N 107 38 41.61 W
CC06	Gold King 7 Level mine adit. Sample water from flow leaving the adit.	37 53 40.50 N 107 38 18.09 W
CC18	Sample water above Gladstone road crossing.	37 53 28.57 N 107 38 57.07 W
CC19	American Tunnel mine adit. Sample flow coming out of the ground.	37 53 27.50 N 107 38 54.39 W
CC48	Cement Creek upstream of confluence with Animas River	37 49 04.07 N 107 39 42.49 W
AR68	Animas River above Cement Creek	37 48 40.34 N 107 39 33.32 W
AR72	Animas River downstream of Silverton	37 47 24.21 N 107 40 03.30 W
AS32	Animas River 32nd Street Bridge, north Durango	37°17'54.82"N 107°52'5.78"W
ARRP	Animas River Rotary Park, Durango	37°16'50.22"N 107°52'35.98"W

Sampling and Field QC Procedures

Samples will be analyzed for the parameters listed on Worksheet 15 and Table 1. Requirements for the sample container, volume, preservation, and QC samples are presented in Table 1: Sampling and Analysis Summary and on Worksheet 19 & 30 of the QAPP.

Sampling and analytical activities performed on site will follow all applicable SOPs outlined in Worksheet 21, including EPA ERT SOP 2001 "General Field Sampling Guidelines". Sampling is anticipated to be performed in Level D personal protective equipment (PPE).

Samples will be collected using equipment and procedures appropriate to the matrix, parameters, and sampling objectives. The volume of the sample collected will be sufficient to perform the analysis requested. Samples will be stored in the proper types of containers and preserved in a manner for the analysis to be performed per laboratory guidelines.

Field water quality parameters will be obtained using a Horiba water quality meter. Field monitoring will be used to measure the quality of water discharged from the treatment system, with emphasis on pH and turbidity measurements. Visual observations of water clarity will be recorded.

Dedicated sampling equipment, sample containers, and PPE will be maintained in a clean, segregated area. Personnel responsible for sampling will change gloves between each sample collection/handling activity. Personnel will use unpowdered nitrile gloves as some types of powder in the powdered gloves contain zinc which could potentially contaminate samples.

START personnel will collect field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples and QA/QC samples as needed during the sampling activities. QA/QC samples will be collected according to the following dictates and summarized on Worksheet 20:

- Blind field duplicate water samples will be collected during sampling activities at locations selected by the START PTL. The data obtained from these samples will be used to assist in the quality assurance of the sampling procedures and laboratory analytical data by allowing an evaluation of reproducibility of results. Efforts will be made to collect duplicate samples in locations where there is visual evidence of contamination or where contamination is suspected. One duplicate sample will be collected for this sampling activity. In general blind field duplicate samples are collected at the rate of one duplicate for every 10 samples collected.
- Field Blank - Field blanks will be prepared by pouring de-ionized water into pre-cleaned laboratory-grade sample containers for analysis. If samples are field filtered for dissolved metals and mercury, the deionized water will be run through the same type of filtration device as the field samples**.** These samples will be prepared to demonstrate the impact the surrounding environment is having on the samples being collected. Field blank samples will be collected once per day for this particular scope of work.
- Temperature Blanks - Each sample cooler shall contain a temperature blank. The temperature blank should be supplied by the receiving laboratory and can a plastic bottle filled with water. The purpose of the temperature blank is to document the temperature of the representative solution contained within the same transport cooler as the collected field sample.
- Equipment Rinsate Blanks - Rinsate blanks will be prepared by pouring de-ionized water over non-disposable sampling equipment after it has been decontaminated and by collecting the rinse water in sample containers for analyses. These samples will be prepared to demonstrate that the equipment decontamination procedures for the sampling equipment were performed effectively. It is anticipated that enough pre-cleaned disposable equipment will be available and that the collection of an equipment rinsate blank will not be needed during this sampling event. However if field conditions change, an equipment rinsate blank will be collected following equipment decontamination procedures.
- Matrix spike (MS) samples will be collected during sampling activities at locations selected by the START PTL. The data obtained from these samples will be used to assist in the quality assurance of the laboratory analytical procedure. Matrix spiking ensures that the laboratory is able to extract an acceptable percentage of a spiked constituent. At the direction of EPA, one matrix spike sample may be collected for every 20 samples submitted for analysis. The matrix spiking analysis often duplicates the spiking procedure on a separate sample volume (MSD).

Additional Sampling/Long Term Considerations

Sampling beyond the initial surface water sampling may be required. Tasks that may be required and implemented at the direction of the EPA OSC include:

- Sampling via ISCO samplers
- Installation of mini-sipper units at designated stations
- Repeat sampling at surface water stations
- Collection of biotic samples

In addition, START will work with EPA to provide support, as needed, to complementary sampling efforts conducted by other agencies collaborating with EPA on the assessment.

Worksheet 18 — Sampling Locations and Methods

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Sections 2.3.1 and 2.3.2)

The following information is project-specific and will be included in the site-specific SAP, and/or QAPP.

Sampling Location / ID	Matrix	Depth (units)	Type	Analyte/Analytical Group	Sampling SOP Reference[1]	Comments
Site ID_mmddyy	Surface Water	TBD	Grab	Metals, Alkalinity, Total Suspended Solids, Total Dissolved Solids, pH		
GKMSW##_mmddyy	Surface Water	TBD	Grab	Metals, Alkalinity, Total Suspended Solids, Total Dissolved Solids, pH		
GKMSD##_mmddyy	Sediment	TBD	Grab/Composite	Metals		
GKMGW##_mmddyy	Groundwater	Unknown	Discrete	Metals, Alkalinity, Total Suspended Solids, Total Dissolved Solids, pH		Groundwater/Well type will be defined by addition of type ID in sample ID nomenclature.
UPDATE	Biotic	Unknown	Discrete	Benthic Macroinvertebrates		

1 Sampling SOPs references are provided in Worksheet 21.

Site ID is previously defined location ID, if exists.

Worksheet 19 & 30 — Sample Containers, Preservation, and Hold Times

(UFP-QAPP Manual Section 3.1.2.2)
(EPA 2106-G-05 Section 2.3.2)

All analyses will be conducted by a CLP laboratory, the Region 8 CRL, or a WESTON-subcontracted laboratory.

Laboratory (Name, sample receipt address, POC, e-mail, and phone numbers): TestAmerica
List Any Required Accreditations/Certifications: TBD
Back-up Laboratory: TBD
Sample Delivery Method: FedEx

Matrix	Analyte/ Analyte Group	Method/ SOP[1]	Container(s) (number, size & type per sample)[2]	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Sediment	Metals	200.7/200.8/245.1	Store @ < 4°C	N/A	180 days	40 days	TBD
Water	Total Metals (including mercury)	200.7/200.8/245.1	One 1-500 mL polyethylene bottle	HNO_3 to pH < 2 and store @ < 4°C	28 days for mercury, 180 days for all other metals	40 days	TBD
	Dissolved Metals (including mercury)	200.7/200.8/245.1	One 1-500 mL polyethylene bottle	Field Filtered: HNO_3 to pH < 2 and store @ < 4°C If not field filtered, no preservative	28 days for mercury, 180 days for all other metals	40 days	TBD
	Total Dissolved Solids	SM2540-C	One 1-Liter polyethylene bottles	Store @ < 4°C	7 days	40 days	TBD
	Total Suspended Solids	SM2540-D	One 1-Liter polyethylene bottles	Store @ < 4°C	7 days	40 days	TBD
	pH	SM4500H+B	One 1-Liter polyethylene bottles	Store @ < 4°C	ASAP	40 days	TBD
	Alkalinity	SM2320B	One 500 mL polyethylene bottle	Store @ < 4°C	N/A	24 hours	TBD

[1] Refer to the Analytical SOP References table (Worksheet 23).
[2] The minimum sample size is based on analysis allowing for sufficient sample for reanalysis. Additional volume is needed for the laboratory MS/MSD sample analysis.

Worksheet 20 — Field Quality Control Sample Summary

(UFP-QAPP Manual Sections 3.1.1 and 3.1.2.)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Analyte/Analytical Group	No. of Field Samples[1]	No. of Field Duplicates	No. of MS/MSD	No. of Field Blanks	No. of Equip. Blanks	No. of Trip Blanks	No. of Other	Total No. of Samples to Laboratory
Surface water	Total Metals	TBD	1 per 10	1 per 20 or 1 per day	1 per 20 or 1 per day	1 per 20 if using non-disposable equipment	0	0	TBD
Surface water	Dissolved Metals	TBS	1 per 10	1 per 20 or 1 per day	1 per 20 or 1 per day	1 per 20 if using non-disposable equipment	0	0	TBD
Groundwater	Total Metals	TBD	1 per 10	1 per 20 or 1 per day	1 per 20 or 1 per day	1 per 20 if using non-disposable equipment	0	0	TBD
Groundwater	Dissolved Metals	TBS	1 per 10	1 per 20 or 1 per day	1 per 20 or 1 per day	1 per 20 if using non-disposable equipment	0	0	TBD
Sediment	Total Metals	TBD	1 per 10	1 per 20 or 1 per day	1 per 20 or 1 per day	1 per 20 if using non-disposable equipment	0	0	TBD

[1] Samples that are collected at different depths at the same location, and analyzed separately, will be counted as separate field samples. Even if they are taken from the same container as the parent field sample, MS/MSDs are counted separately, because they are analyzed separately. If composite samples or incremental samples are collected, only the sample that will be analyzed will be included; subsamples and increments will not be listed separately.

[2] Total number of samples to the laboratory does not include MS/MSD samples.

Note: If EPA requests that field samples be collected from treatment system water and analyzed for total and dissolved metals, the need for a duplicate will be determined based on the rationale for sampling. The number and types of QC samples will be based on project-specific DQOs and this worksheet will be adapted, as necessary, to accommodate project-specific requirements. Project-specific QC samples may include field duplicate, field blank, equipment blank, trip blank, field split, MS/MSD, and PT samples and will be collected in accordance with the frequencies recorded on QAPP Worksheet 12. Quality Assurance Assessment and Corrective Actions are found in QAPP Worksheet #28.

Worksheet 21 — Field SOPs

(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

SOPs may include, but are not limited to, those identified in the table below.

SOP Number or Reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
2006	Sampling Equipment Decontamination, 6/2011	U.S. EPA, ERT		N	
2007	Groundwater Well Sampling, 6/2011	U.S. EPA, ERT		N	
2012	Soil Sampling, 6/2011	U.S. EPA, ERT		N	
2013	Surface Water Sampling, 6/2011	U.S. EPA, ERT		N	
2016	Sediment Sampling, 6/2011	U.S. EPA, ERT		N	
2017	Waste Pile Sampling, 6/2011	U.S. EPA, ERT		N	
2043	Water Level Measurement, 6/2011	U.S. EPA, ERT		N	
2049	Investigation-Derived Waste (IDW) Management, 6/2011	U.S. EPA, ERT		N	
G-12	Specifications and Guidance for Contaminant-Free Sample Containers, 12/1992	U.S. EPA, Office of Solid Waste and Emergency Response		N	
SS-5	Residential Soil Lead Sampling Guidance, 4/2000	U.S. EPA R8 Superfund Program		N	
NN2044	Monitoring Well Development, 6/2011	U.S. EPA, ERT		N	
2001	General Field Sampling Guidelines, 6/2011	U.S. EPA, ERT		N	
CDPHE 2010	Standard Operating Procedures for the Collection of Water Samples, 2010 https://www.colorado.gov/pacific/sites/default/files/WQ_nonpoint_source-SOP-Collection-of-Water-Chemistry-Samples-050110.pdf	CDPHE		N	
WQCDSOP-001	Benthic Macroinvertebrate Sampling Protocols, 2010.	CDPHE		N	

START will review existing information and may conduct sampling for removal/emergency response activities. Environmental samples will be collected for analysis at the EPA Region 8 CRL, ESAT laboratory, or by subcontracted laboratories.

Inclusive of the U.S EPA Region 8 Removal and Emergency Response Program, START may conduct a wetland determination on a site-specific basis in accordance with the methods described in the *Corps of Engineers Wetlands Delineation Manual (USACE 1987,* http://www.usace.army.mil/Missions/CivilWorks/RegulatoryProgramandPermits/reg_supp.aspx*)*, regional supplemental guidance, and subsequent clarification memoranda. The wetland determination is based on a three-parameter approach that requires evidence of the following wetland indicators: dominant hydrophytic vegetation, hydric soil characteristics, and the presence of wetland hydrology. An area must meet all three wetland indicator criteria (except where noted in the USACE 1987 Supplemental Manuals) to be considered a jurisdictional wetland.

During sampling activities, IDW may be generated. IDW may consist of decontamination fluids, purge/development water, excess sampled media (e.g., soil, sediment, water, etc.), disposable sampling supplies, and PPE (e.g., Tyvek/Saranex coveralls, gloves, booties, etc.). Handling of IDW will be performed according with SOP 2049 as listed above as well as procedures described in *Management of Investigation Derived Wastes during Site Inspections (May 1991*). Waste disposal for IDW will be dependent upon classification of the waste as either RCRA hazardous or RCRA nonhazardous waste.

Worksheet 22 — Field Equipment Calibration, Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

START field personnel are responsible for the calibration of EPA field equipment and field equipment provided by subcontractors. Documented and approved procedures will be used for calibrating measuring and testing equipment. Widely accepted procedures, such as those published by U.S. EPA and ASTM, or procedures provided by manufacturers in equipment manuals will be adopted. Items may include, but are not limited to those identified in the table below.

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Title or Position of Responsible Person	Verification	SOP Reference[1]
Horiba U-50/YSI® 600XLM Water Quality Meters	Calibrate probes with standards per instrument instruction manual	Check batteries, clean probes, store in manufacturer recommended solution	Calibration check	Visually inspect for external damage to probe(s)	Refer to instrument SOP	Refer to instrument SOP	Refer to instrument SOP	Field personnel	WAM/COR	G-13/G-14
Water Level Indicators	Calibrate tape against calibrated steel measuring tape	Clean prior and after each use, check battery	Calibration and operational equipment check	Visually inspect for obvious defects, broken parts, or cleanliness	Prior to use	Equipment operational	Repair/ replace as needed	Field personnel	WAM/COR	Instrument-Specific
Sampling Tools (Disposable Scoops)	NA	NA	NA	Visually inspect for obvious defects or broken parts	Prior to use	NA	Replace	Field personnel	WAM/COR	NA
Disposable, inert sample mixing containers	NA	NA	NA	Visually inspect for cleanliness	Prior to use	NA	Replace	Field personnel	WAM/COR	NA
Metal sampling equipment as necessary (trowels)	NA	Clean prior and after each use	NA	Visually inspect for cleanliness	Prior to use	Should be covered from previous decontamination procedure	Perform decontamination procedure again as needed	Field personnel	NA	Metal sampling equipment as necessary (trowels)

Grundfos Readiflow 2 Submersible Pump	NA	Clean prior and after each use	Operational equipment check	Visually inspect for obvious defects, broken parts, or cleanliness	Prior to use	Equipment operational	Repair/ replace as needed	Field personnel	WAM/COR	Instrument-Specific
MiniSipper	Calibrate by method with standard soutions	If poor instrument performace, replace tungsten lamp	Calibration and operational equipment check	Visually inspect for obvious defects, broken parts, or cleanliness	Prior to use	Equipment operational	Repair/ replace as needed	Field personnel	WAM/COR	Instrument-Specific
ISCO samplers	Perform volume calibration	Clean pump tubing, suction line, bottles, humidity indicator, and replace batteries	Calibration and operational equipment check	Visually inspect for obvious defects, broken parts, or cleanliness	Prior to use	Equipment operational	Repair/ replace as needed	Field personnel	WAM/COR	Instrument-Specific
Sampling Sticks	NA	NA	NA	Visually inspect for obvious defects or broken parts	Prior to use	NA	Replace	Field personnel	WAM/COR	NA

[1] Refer to Field SOPs (Worksheet 21) and Analytical SOPs (Worksheet 23).

Worksheet 23 — Analytical SOPs

(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

Items may include, but are not limited to those identified in the table below.

Lab SOP Number[1]	Title, Revision Date, and/or Number and URL (if available)	Screening or Definitive Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project? (Y/N)
TBD	METHOD 200.7 DETERMINATION OF METALS AND TRACE ELEMENTS IN WATER AND WASTES BY INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY, 1994, http://water.epa.gov/scitech/methods/cwa/bioindicators/upload/2007_07_10_methods_method_200_7.pdf	Definitive	Water/Soil	ICP-AES	TBD
TBD	METHOD 200.8 DETERMINATION OF TRACE ELEMENTS IN WATERS AND WASTES BY INDUCTIVELY COUPLED PLASMA - MASS SPECTROMETRY, 1994, http://water.epa.gov/scitech/methods/cwa/bioindicators/upload/2007_07_10_methods_method_200_8.pdf	Definitive	Water/Soil	ICP-MS	TBD
TBD	METHOD 245.1 Mercury (Manual Cold Vapor Technique) http://www.bucksci.com/catalogs/245_1.pdf	Definitive	Water/Soil	CVAA	TBD
TBD	METHOD SM 2540 D Low Level Total Suspended Solids Dried at 103-105 Deg C 20th Ed. http://www.standardmethods.org/store/ProductView.cfm?ProductID=63	Definitive	Water/Soil	Gravimetry	TBD
TBD	METHOD SM 2540 C Low Level Total Dissolved Solids Dried at 103-105 Deg C 20th Ed. http://www.standardmethods.org/Store/ProductList.cfm	Definitive	Water/Soil	Gravimetry	TBD
TBD	METHOD SM 4500H+B pH Value in Water by Potentiometry Using a Standard Hydrogen Electrode. http://standardmethods.org/	Definitive	Water/Soil	pH Meter	TBD

Worksheet 23 — Analytical SOPs (Continued)

(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

SOM01.2	U.S. EPA CLP Statement of Work for Organic Analysis, SOM01.1, 5/2005, http://www.epa.gov/superfund/programs/clp/download/som/som11a-c.pdf MODIFICATIONS UPDATING SOM01.1 TO SOM01.2, 4/2007, http://www.epa.gov/superfund/programs/clp/download/som/som11tosom12mods.pdf	Definitive	Soil, sediment, debris, water, aquatic animal tissue/VOCs, SVOCs, Pesticides, Aroclors	Analyte specific	TBD
ISM01.3	U.S. EPA CLP Statement of Work for Inorganic Analysis, ISM01.2, 1/2010, http://www.epa.gov/superfund/programs/clp/download/ism/ism12a-c.pdf MODIFICATIONS UPDATING ISM01.2 TO ISM01.3, http://www.epa.gov/superfund/programs/clp/download/ism/ism12toism13mods.pdf	Definitive	Soil, sediment, debris, water, aquatic animal tissue/Metals and cyanide	Analyte specific	TBD

[1] Lab SOP numbers are lab-specific and will be identified in the site-specific SAP, and/or QAPP.

Worksheet 24 — Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

As stated in Worksheet 22, START field personnel are responsible for the calibration of EPA and sub-contractor provided analytical field equipment. Documented and approved procedures will be used for calibrating measuring and testing equipment. Widely accepted procedures, such as those published by U.S. EPA and ASTM, or procedures provided by manufacturers in equipment manuals will be adopted.

The responsibility for the calibration of laboratory equipment rests with the selected laboratories. Each type of instrumentation and each U.S. EPA-approved method have specific requirements for the calibration procedures, depending on the analytes of interest and the sample medium. The calibration procedures and frequencies of the equipment used to perform the analyses will be in accordance with requirements established by the U.S. EPA. The laboratory QA manager will be responsible for ensuring that the laboratory instrumentation is maintained in accordance with specifications. Individual laboratory SOPs will be followed for corrective actions and preventative maintenance frequencies. Laboratory quality control, calibration procedures, corrective action procedures, and instrument preventative maintenance will be included in an addendum to this QAPP once the laboratories have been selected for each of the TBA sites. Items may include, but are not limited to those identified in the table below.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference[1]
CVAA	200.7/200.8/245.1	Daily initial calibration prior to sample analysis. Perform instrument re-calibration once per year minimum.	$R^2 \geq 0.995$ for linear regression	Correct problem then repeat initial calibration. If calibration fails again, re-digest the entire digestion batch.	Lab Manager/ Analyst	200.7/200.8/245.1

ICP-AES	200.7/200.8/245.1	Calibration and initial calibration verification after instrument set up, then daily; continuing calibration verifications. Upper range within 10%. New upper range limits should be determined whenever a significant change in instrument response or every six months. Low-level continuing calibration verification (LLCCV) standard with 30%.	Initial and continuing calibration verification within ± 10% of upper range true values and ± 30% LLCCV true values.	Inspect system; correct problem; re-run calibration and affected samples	Lab Manager/ Analyst	200.7/200.8/245.1
ICP/ ICP-MS	200.7/200.8/245.1	Calibration and initial calibration verification after instrument set up, then daily; continuing calibration verification 10% or every 2 hours, whichever is more frequent	Calibration r2 >0.995; initial and continuing calibration verification within ± 20% of true values	Inspect system; correct problem; re-run calibration and affected samples	Lab Manager/ Analyst	200.7/200.8/245.1

[1] Refer to the Analytical SOPs table (Worksheet 23).

Worksheet 25 — Analytical Instrument and Equipment Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.2.3)
(EPA 2106-G-05 Section 2.3.6)

All laboratories conducting analyses of samples collected under the contract are required to have a preventative maintenance program covering testing, inspection, and maintenance procedures and schedule for each measurement system and required support activity. The basic requirements and components of such a program include the following:

Instrument / Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/ Position Responsible for CA	SOP Reference[1]
CVAA	Replace disposables, flush lines, check lamp current and gas flow	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	200.7/200.8/245.1
ICP-AES	Replace disposable, flush lines, and clean autosampler	Analytical standards	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	200.7/200.8/245.1
ICP/ICP-MS	Replace pump windings and gas tanks, check standard and sample flow	Monitor instrument standard (ISTD) counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Replace windings, recalibrate and reanalyze	Analyst	200.7/200.8/245.1

[1] Refer to the Analytical SOPs table (Worksheet 23). A laboratory-specific QA Manual may be referenced on a project-specific basis and will be identified in the site specific SAP, and/or QAPP.

Worksheet 26 & 27 — Sample Handling, Custody, and Disposal

(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Manual Section 2.3.3)

Examples of field form (Appendix F), chain-of-custody (Appendix G), and sample label and custody seal (Appendix H) documentation are attached. SOPs for sample handling (identified in the table below) are located in Appendix I.

Sampling Organization: WESTON
Laboratory: Project-Specific - TBD
Method of sample delivery (shipper/carrier): Project-Specific - TBD
Number of days from reporting until sample disposal: Project-Specific - TBD

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	Field Personnel	SOP G-1 & G-3
Chain-of-Custody Form Completion	Field Personnel	SOP G-8
Sample Packaging	Field Personnel	SOP G-9
Shipping Coordination	Field Personnel	SOP G-9
Sample Receipt, Inspection, & Log-in	Laboratory Sample Custodian	TBD – Per Laboratory SOP
Sample Custody and Storage	Laboratory Sample Custodian /Laboratory Analytical Personnel	TBD – Per Laboratory SOP
Sample Disposal	Field Personnel/Laboratory Sample Custodian /Laboratory Analytical Personnel	SOP G-1 & G-3/ TBD – Per Laboratory SOP

Supplies and consumables can be received at a START office, U.S. EPA Warehouse or at a site. When supplies are received at a START office or U.S. EPA Warehouse, the PM or PTL will sort the supplies according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. The item will then be returned to the vendor for replacement or repair.

Procedures for receiving supplies and consumables in the field are similar to those described above. Upon receipt, items will be inspected by the START PM or PTL against the acceptance criteria. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

Worksheet 28 — Analytical Quality Control and Corrective Action

(UFP-QAPP Manual Section 3.4 and Tables 4, 5, and 6)
(EPA 2106-G-05 Section 2.3.5)

The following information is laboratory-specific. The following are typical examples for Organics and Inorganics for all media.

Matrix: All
Analytical Group: All
Analytical Method/SOP: All/All

QC Sample	Number/Frequency	Method/SOP QC Acceptance Limits[1]	Corrective Action	Title/Position of Person Responsible for Corrective Action	Project-Specific MPC
Method Blank	1/Batch (20 samples)	No Target Compounds >1/2 RL; no common lab contaminants >RL.	If sufficient sample is available, reanalyze samples. Qualify data as needed. Report results if sample results >10x blank result or sample results non-detect (ND).	Analyst / Section Supervisor	No Target Compounds >1/2 RL; no common lab contaminants >RL.
LCS	1/Batch (20 samples)	Analyte-specific	If sufficient sample is available, reanalyze samples. Qualify data as needed.	Analyst / Section Supervisor	Laboratory % Recovery Control Limits
MS/MSD	1/Batch (20 samples)	Analyte-specific	Determine root cause; flag MS/MSD data; discuss in narrative.	Analyst / Section Supervisor	Laboratory % Recovery / RPD Control Limits
Surrogates	Every sample	Refer to the laboratory-specific QA Manual and/or the U.S. EPA National Functional Guidelines for Organic Data Review Table Surrogate control limits	Check calculations and instrument performance; recalculate, reanalyze.	Analyst / Section Supervisor	Laboratory % Recovery Control Limits
Dilution Test	One per preparatory batch	1:5 dilution must agree within ±10% of the original determination	Perform post digestion spike addition	Analyst / Section Supervisor	Only applicable for samples with concentrations > 50x Limit of Detection (LOD)

Field and laboratory QC samples and measurements will be used to verify that analytical data meet project-specific MPC, which are based on Project Quality Objectives (PQOs)/DQOs. Field QC samples and measurements and laboratory QC samples will be used to assess how they influence data quality. The project-specific SAP, and/or QAPP will include the information presented in the table above for each sampling technique, analytical method/SOP, matrix, and analytical group. See Worksheet 12 and 20 for descriptions of QC samples, DQIs, and MPC.

Worksheet 29 — Project Documents and Records

(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

All records will be generated and verified by START personnel only, stored electronically on the START server and backed up daily. All hard and electronic copies of finalized documents and technical project documents (including but not limited to the QAPP, HASP, etc.) will be retained in accordance with Section H.20 of Contract No.: EP-S8-13-01. Other project-related files, such as contract documents, employee benefits, and other information will be retained in accordance with WESTON Policies and Procedures.

Sample Collection and Field Records			
Record	**Generation**	**Verification**	**Storage Location/Archival**
Field Logbook or Data Collection Sheets	PTL/Field Scientist	Delegated QA Manager	Project File
Chain-of-Custody (COC) Forms	PTL/Field Scientist	Delegated QA Manager	Project File
Custody Seals	PTL/Field Scientist	Delegated QA Manager	Project File
Air Bills	PTL/Field Scientist	Delegated QA Manager	Project File
Daily QC Reports	PTL	Delegated QA Manager	Project File
Deviations	PTL/Field Scientist	Delegated QA Manager	Project File
Corrective Action Reports	Delegated QA Manager	PM	Project File
Correspondence	PTL	Delegated QA Manager	Project File
Field Sample Results/Measurements	PTL/Field Scientist	Delegated QA Manager	Project File
Tailgate Safety Meeting Items	PTL/Field Safety Officer	Delegated QA Manager	Project File

Project Assessments			
Record	**Generation**	**Verification**	**Storage Location/Archival**
Field Analysis Audit Checklist	Delegated QA Manager	PM	Project File
Fixed Laboratory Audit Checklist	Delegated QA Manager	PM	Project File
Data Verification Checklists	Delegated QA Manager	PM	Project File
Data Validation Report	Delegated QA Manager	PM	Project File
Data Usability Assessment Report	Delegated QA Manager	PM	Project File
Corrective Action Reports	Delegated QA Manager	PM	Project File
Correspondence	Delegated QA Manager	PM	Project File

Laboratory Records			
Record	**Generation**	**Verification**	**Storage Location/Archival**
Sample Receipt, Custody, and Checklist	Laboratory Sample Receiving	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Equipment Calibration Logs	Laboratory Technician	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Standard Traceability Logs	Laboratory Technician	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Sample Prep Logs	Laboratory Technician	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Run Logs	Laboratory Technician	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Equipment Maintenance, Testing, and Inspection Logs	Laboratory Technician/ Laboratory QA Manager	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Corrective Action Reports	Laboratory QA Manager	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Laboratory Analytical Results	Laboratory Technician/ Laboratory QA Manager	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Laboratory QC Samples, Standards, and Checks	Laboratory Technician/ Laboratory QA Manager	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Instrument Results (raw data) for Primary Samples, Standards, QC Checks, and QC Samples	Laboratory Technician/ Laboratory QA Manager	Laboratory PM/Delegated QA Manager	Laboratory and Project File
Sample Disposal Records	Laboratory Technician	Laboratory PM/Delegated QA Manager	Laboratory and Project File

Worksheet 29 — Project Documents and Records (Continued)

(UFP-QAPP Manual Section 3.5.1)
(EPA 2106-G-05 Section 2.2.8)

Laboratory Data Deliverables[1]						
Record	**VOCs**	**SVOCs**	**PCBs**	**Pesticides**	**Metals**	**Other**
Narrative						
COC						
Summary Results						
QC Results						
Chromatograms						
Tentatively Identified Compounds						

[1] The Laboratory Data Deliverables table is designed to be a checklist for use in supporting data completeness. The records and analytical groups in this table are not all inclusive of those that may be used on a specific project and should be modified and utilized by the Delegated QA Manager as applicable.

Worksheet 31, 32 & 33 — Assessments and Corrective Action

(UFP-QAPP Manual Sections 4.1.1 and 4.1.2)
(EPA 2106-G-05 Section 2.4 and 2.5.5)

All reports will be prepared by WESTON and distributed to the following to include but not be limited to the WESTON PM, Program Manager and Delegated QA Manager, and the U.S. EPA COR, WAM, and DAO as applicable.

Assessment Type	Responsible Party & Organization	Number/ Frequency	Estimated Dates	Assessment Deliverable	Deliverable Due Date
Laboratory TSA[2]	DAO/WAM/COR EPA Laboratory QA Manager TBD Delegated QA Manager WESTON	CLP, CRL, and certified sub-contract laboratories are routinely audited by accrediting authorities. The laboratory QA manager and/or WESTON Delegated QA Manager will perform audits on a project-specific basis as needed	TBD	Analytical TSA Memorandum and Checklist	TBD
Management Review	DAO/WAM/COR EPA Delegated QA Manager and PM WESTON	1/year	TBD	QA Management Report	TBD
Corrective Action	DAO/WAM/COR EPA Delegated QA Manager and PM WESTON	TBD	TBD	Corrective Action Reports	TBD
Data Validation	Chemist WESTON	TBD	TBD	Data Validation Report	TBD
Contract Closeout	Program Manager WESTON	1	TBD	Contract Closeout Report	TBD

1 Field sampling TSAs may include, but are not limited to the following: sample collection records; sample handling, preservation, packaging, shipping, and custody records; equipment operation, maintenance, and calibration records.

2 Laboratory TSAs may include, but are not limited to the following: sample log-in, identification, storage, tracking, and custody procedures; sample and standards preparation procedures; availability of analytical instruments; analytical instrument operation, maintenance, and calibration records; laboratory security procedures; qualifications of analysts; case file organization and data handling procedures.

Worksheet 34 — Data Verification and Validation Inputs

(UFP-QAPP Manual Section 5.2.1 and Table 9)
(EPA 2106-G-05 Section 2.5.1)

The following informationwill be used during data verification and validation. Inputs may include, but are not limited to those identified in the table below.

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
3	Field SOPs	X	
4	Laboratory SOPs	X	
5	Laboratory QA Manual	X	
6	Laboratory Certifications	X	
Field Records			
7	Field Logbooks	X	X
8	Equipment Calibration Records	X	X
9	COC Forms	X	X
10	Sampling Diagrams/Surveys	X	X
11	Drilling Logs	X	X
12	Geophysics Reports	X	X
13	Relevant Correspondence	X	X
14	Change Orders/Deviations	X	X
15	Field Audit Reports	X	X
16	Field Corrective Action Reports	X	X
17	Sample Location Verification (Worksheet 18)	X	X
Analytical Data Package			
18	Cover Sheet (laboratory identifying information)	X	X
19	Case Narrative	X	X
20	Internal Laboratory COC	X	X
21	Sample Receipt Records	X	X
22	Sample Chronology (i.e. dates and times of receipt, preparation, & analysis)	X	X
23	Communication Records	X	X
24	Project-specific PT Sample Results	X	X
25	LOD/LOQ Establishment and Verification	X	X
26	Standards Traceability	X	X
27	Instrument Calibration Records	X	X
28	Definition of Laboratory Qualifiers	X	X
29	Results Reporting Forms	X	X
30	QC Sample Results	X	X
31	Corrective Action Reports	X	X
32	Raw Data	X	X
33	Electronic Data Deliverable	X	X

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Worksheet 35 — Data Verification Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

The following information may include, but are not limited to those identified in the table below.

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
Approved QAPP	Programmatic and site-specific SAP, and/or QAPP, Contract	Verify completeness, correctness, and contractual compliance of all project QA/QC and data set against the methods, SOPs, and contract requirements conforms.	Jan Christner, P.E., WESTON Cecilia H. Shappee, P.E., WESTON David Robinson, WESTON, TBD
Field SOPs	Programmatic and site-specific SAP, and/or QAPP, SOPs	Ensure that all field sampling SOPs were followed.	Jan Christner, P.E., WESTON
Analytical SOPs	Programmatic and site-specific SAP, and/or QAPP, SOPs	Ensure that all laboratory analytical SOPs were followed.	Tana Jones, PMP, WESTON Laboratory PM, TBD
Field Logbook, Field Sheets, Sample Diagrams/ Surveys	Programmatic and site-specific SAP, and/or QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that meteorological data were provided for each day of field activities. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed and results are documented.	Jan Christner, P.E., WESTON
Equipment Calibration Records	Programmatic and site-specific SAP, and/or QAPP, SOPs, field logbook	Ensure that all field analytical instrumentation SOPs and laboratory analytical SOPs for equipment calibration were followed.	Tana Jones, PMP, WESTON Laboratory PM, TBD

Records Reviewed	Required Documents	Process Description	Responsible Person, Organization
COC Forms	Programmatic and site-specific SAP, and/or QAPP	Verify the completeness of COC records. Examine entries for consistency with the field logbook. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Jan Christner, P.E., WESTON Laboratory PM, TBD
Relevant reports, and correspondence	Programmatic and site-specific SAP, and/or QAPP	Verify that reports are present and complete for each day of field activities. Verify that correspondence are documented and were reported in accordance with requirements.	Jan Christner, P.E., WESTON
Laboratory Deliverable	Programmatic and site-specific SAP, and/or QAPP	Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with COCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Jan Christner, P.E., WESTON Moira Pryhoda, WESTON
Audit Reports, Corrective Action Reports	Programmatic and site-specific SAP, and/or QAPP	Verify that all planned audits were conducted. Examine audit reports. For any deficiencies noted, verify that corrective action was implemented according to plan.	Jan Christner, P.E., WESTON Moira Pryhoda, WESTON Laboratory PM, TBD

Worksheet 36 — Data Validation Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Data Validator: START

Analytical Group/ Method	Data Deliverable Requirements	Analytical Specifications	MPC	Percent of Data Packages to be Validated	Percent of Raw Data Reviewed	Percent of Results to be Recalculated	Validation Procedure	Validation Code[1]	Electronic Validation Program/ Version
Total and Dissolved Metals	Scribe Compatible EDD	QAPP Worksheet 28	Worksheets 11, 12, 19 & 30	10%	0%	0%	U.S. EPA Stage 2A	SV2aE	N/A

[1] Validation Codes are provided in Appendix M.

Validation will be performed on all laboratory analytical data unless a defined quantity or percentage of samples is identified by the U.S. EPA in the Technical Direction Document or during the project scoping meeting on a project-specific basis.. Project validation criteria as per QAPP Worksheets 12, 15, 19 & 30, 28, and 36, and cited EPA SW-846 methodology will be used. WESTON-contracted laboratory data packages will be verified and validated using a Stage 2A validation, as described in the EPA *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (January 2009) (Appendix J) unless otherwise specified by the U.S. EPA WAM/COR during the development of the DQOs. Validation Qualifiers will be applied using the following hierarchy: Region 8 UFP-QAPP for Removal Actions and Emergency Responses; the site-specific SAP, and/or QAPP; *EPA National Functional Guidelines for Organic Data Review* (Appendix K); *EPA National Functional Guidelines for Inorganic Data Review* (Appendix L); EPA Publication SW-846; and the laboratory-specific SOP. Methods for which no data validation guidelines exist will be validated following the guidance deemed most appropriate by the data validator.

The data validator will receive all laboratory packages and analytical results electronically. Additionally, the validator will be required to submit final validation reports via PDF format and must provide an annotated laboratory analytical result electronic data deliverable (EDD) with applicable data validation qualifiers (Appendix M) identified in the site-specific SAP, and/or QAPP, and/or result value modifications. The Delegated QA Manager will use EPA document *Using Qualified Data to Document an Observed Release and Observed Contamination* (July 1996) to aid in determining the use of qualified data to document all observed release and observed contamination by chemical analysis under U.S. EPA's HRS. Approved data will be released by the Delegated QA Manager for reporting.

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Worksheet 37 — Data Usability Assessment

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

Personnel (organization and position/title) responsible for participating in the data usability assessment may include, but not be limited to:

- START PM;
- START Delegated QA Manager;
- START Risk Assessor;
- START Chemist;
- START PTL;
- START Statistician.

Based on project-specific oversight responsibilities and analytical scopes, this data usability assessment worksheet outlines the approach that will be taken as the analytical scope expands on a project-specific basis. The following general steps will be followed to assure that the data usability assessment evaluates whether underlying assumptions used during systematic planning are supported, sources of uncertainty have been accounted for and are acceptable, data are representative of the population of interest, and the results can be used as intended, with the acceptable level of confidence:

- Step 1 – Review the project's objectives and sampling design;
- Step 2 – Review the data verification and data validation outputs;
- Step 3 – Verify the assumptions of the selected statistical method;
- Step 4 - Implement the statistical method;
- Step 5 – Document data usability and draw conclusions.

The data usability assessment is considered the final step in the data evaluation process; all data will be assessed for usability, regardless of the data evaluation/validation process implementation. Data usability goes beyond validation in that it evaluates the achievement of the DQOs based on the comparison of the project DQIs and individual study-specific work plans, with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be reported in accordance with Worksheet 6.

Primarily, the assessment of the usability will follow procedures described in appropriate EPA guidance documents, particularly *Guidance for Data Usability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992)(Appendix U), and will be conducted according to the process outlined below.

1. **Sampling and Analysis Activities Evaluation**: The first part of the data usability evaluation will include a review of the sampling and analysis activities in comparison to project-specific DQIs and study-specific work plans. Specific limitations to the data (i.e., results that are qualified as estimated [J/UJ], or rejected [R], will be determined and documented in the database).

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

2. **Achievement of DQIs**: The second part of data usability pertains to the achievement of the program-specific DQIs. Each investigator will compare the performance achieved for each data quality criterion against the expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. This comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from re-sampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. In the event that corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

   In conjunction with the DQI achievement review, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (bias, imprecision, etc.) of the qualified results. Cumulative QC exceedances from the DQIs may require technical judgment to determine the overall effect on the usability of the data. Decisions about usability of qualified data for use in risk assessment will be based on the EPA document mentioned, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of this overall examination and decision process.

3. **Achievement of DQOs**: The final part in the data usability process concerns achievement of the DQOs. Once the data set has been assessed to be of known quality, data limitations have been documented, and overall result applicability/usability for its intended purpose has been determined, the final data assessment can be initiated by considering the answers to the following questions:

   - Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they were expected to migrate from potential hazardous substance source areas?
   - Do the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
   - Are the data statistically adequate to evaluate on a per chemical and per media basis?
   - Do the data collected allow assessment of hydrogeologic factors, which may influence contaminant migration/distribution?
   - Do laboratory reporting limits attain the applicable state and/or federal standards and/or screening levels?
   - Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

- Have sufficient data been collected to evaluate how factors including physical characteristics of the site and climate and water table fluctuations affect contaminant fate and transport?
- Have sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
- Is the data set sufficient to evaluate the potential extent and risk of future releases of hazardous substances, which may remain as residual contamination at the source facility?

Principal investigators, in conjunction with the project team, will formulate solutions if data gaps are found as a result of problems, biases, trends, etc., in the analytical data, or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically address any limitations on the use of the data that may result from a failure to achieve the stipulated DQO.

If the project scope changes, the DQOs will be expanded. The DQOs will address the specific action limits and measurable performance criteria, in order to make appropriate decisions on the analytical data.

DQIs, such as precision, accuracy, completeness, representativeness, and comparability measurements, aid in the evaluation process and are discussed below.

Precision

The most commonly used estimates of precision are the RPD for cases in which only two measurements are available, and the percent RSD (%RSD) when three or more measurements are available. This is especially useful in normalizing environmental measurements to determine acceptability ranges for precision because it effectively corrects for the wide variability in sample analyte concentration indigenous to samples.

Precision is represented as the RPD between measurement of an analyte in duplicate samples or in duplicate spikes. RPD is defined as follows:

$$RPD = \frac{|C_1 - C_2|}{\frac{C_1 + C_2}{2}} \times 100$$

Where:

C_1 = First measurement value
C_2 = Second measurement value

For field measurements such as pH, where the absolute variation is more appropriate, precision is often reported as the absolute range (D) of duplicate measurements:

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

$$\%D = m1 - m2$$

Where:
$m1$ = First measurement value
$m2$ = Second measurement value
The % RSD is calculated by the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This method of precision measurement can be expressed by the formula:

$$\%\text{RSD} = \frac{\sqrt{\sum_{I-1}^{N}\left(\frac{\text{RF}_i - \text{RF}}{\text{N - 1}}\right)}}{\text{RF}} \text{ x } 100$$

Where:
RF = Response factor
N = Number of measurements

Precision control limits for evaluation of sample results are established by the analysis of control samples. The control samples can be method blanks fortified with surrogates (e.g., for organics), or LCS purchased commercially or prepared at the laboratory. The LCS is typically identified as blank spikes (BS) for organic analyses. For multi-analyte methods, the LCS or BS may contain only a representative number of target analytes rather than the full list.

The RPD for duplicate investigative sample analysis provides a tool for evaluating how well the method performed for the respective matrix.

Accuracy/Bias

Accuracy control limits are established by the analysis of control samples, which are in water and/or solid/waste matrices. For organic analyses, the LCS may be a surrogate compound in the blank or a select number of target analytes in the blank spike. The LCS is subjected to all sample preparation steps. When available, a solid LCS may be analyzed to demonstrate control of the analysis for soil. The amount of each analyte recovered in an LCS analysis is recorded and entered into a database to generate statistical control limits. These empirical data are compared with available method reference criteria and available databases to establish control criteria.

The %R for spiked investigative sample analysis (e.g., matrix spike) provides a tool for evaluating how well the method worked for the respective matrix. These values are used to assess a reported result within the context of the project data quality objectives. For results that are outside control limits provided as requirements in the QAPP, corrective action appropriate to the project will be taken and the deviation will be noted in the case narrative accompanying the sample results. Percent recovery (%R) is defined as follows:

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

$$\% \text{Recovery} = \frac{(A_T - A_0)}{A_F} \times 100$$

Where:
A_T = Total amount recovered in fortified sample
A_0 = Amount recovered in unfortified sample
A_F = Amount added to sample

Accuracy for some procedures is evaluated as the degree of agreement between a new set of results and a historical database or a table of acceptable criteria for a given parameter. This is measured as percent difference (%D) from the reference value, and is primarily used by the laboratory as a means for documenting acceptability of continuing calibration.

The %D is calculated by expressing, as a percentage, the difference between the original value and new value relative to the original value. This method for precision measurement can be expressed by the formula:

$$\% D = \frac{C_1 - C_2}{C_1} \times 100$$

Where:
C_1 = Concentration of analyte in the initial aliquot of the sample.
C_2 = Concentration of analyte in replicate.

The laboratory will review the QC samples and surrogate recoveries for each analysis to ensure that the %R lies within the control limits listed in the UFP-QAPP. Otherwise, data will be flagged by the laboratory.

For field measurements such as pH, accuracy is often expressed in terms of bias (B) and is calculated as follows:

$$B = M - A$$

Where:
M = Measured value of Standard Reference Material (SRM)
A = Actual value of SRM

Sensitivity

Sensitivity is the ability of the analytical test method and/or instrumentation to differentiate between detector responses to varying concentrations of the target constituent. Methodology to establish sensitivity for a given analytical method or instrument includes examination of standardized blanks, instrument detection limit studies, and calibration of the QL. The findings of the usability of the data relative to sensitivity will be included in the report, including any limitations on the data set and/or individual analytical results.

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

The Precision, Accuracy, Representativeness, Completeness, Comparability and Sensitivity MPC are described in Worksheets 12, 15, and 28. The following steps will be performed:

- Evaluate if the project required quantitation limits listed in Worksheet 15 were achieved for non-detected site contaminants. If no detectable results were reported and data are acceptable for the verification and validation steps, then the data are usable.
- If detectable concentrations are reported and the verification and validation steps are acceptable, the data are usable.
- If verification and validation are not acceptable, the data are qualified, estimated (J, UJ) for minor QC deviations that do not affect the data usability, or rejected for major QC deviations affecting data usability. The impact of rejected data will be evaluated and re-sampling may be necessary. Use of estimated data will be discussed in the project report.
- For statistical comparisons and mathematical manipulations, non-detect values will be represented by a concentration equal to one-half the sample-specific reporting limit. Duplicate results (original and duplicate) will not be averaged for the purpose of representing the range of concentrations. However, the average of the original and duplicate will be used to represent the concentration at that sample location.

Statistical tests will be conducted to identify potential outliers. Potential outliers will be removed if a review of the field and laboratory documentation indicates that the results are true outliers.

Method sensitivity is typically evaluated in terms of the method detection limit (MDL) and is defined as follows for many measurements:

$$MDL = {}^{t}(n - 1, 1 - \alpha = 0.99)(s)$$

Where:

s = Standard deviation of the replicate analyses
${}^{t}(n - 1, 1 - \alpha = 0.99)$ = Student's t-value for a one-sided 99 percent confidence level and a standard deviation estimate with n-1 degrees of freedom
n = Number of measurements
α = Statistical significance level

Representativeness

Representativeness is the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. It is a qualitative parameter that depends on proper design of the sampling program.

Data representativeness for this project is accomplished by implementing approved sampling procedures and analytical methods that are appropriate for the intended data uses, and which are established within the site-specific SAP, and/or QAPP.

Field personnel will be responsible for collecting and handling samples according to the procedures in this UFP-QAPP and the site-specific SAP, and/or QAPP so that samples are representative of field conditions. Errors in sample collection, packaging, preservation, or chain-of-custody

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

procedures may result in samples being judged non-representative and may form a basis for rejecting the data.

Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another, whether it was generated by a single laboratory or during inter-laboratory studies. The use of standardized field and analytical procedures ensures comparability of analytical data. Sample collection and handling procedures will adhere to U.S. EPA-approved protocols. Laboratory procedures will follow standard analytical protocols, use standard units, use standardized report formats, follow the calculations as referenced in approved analytical methods, and use a standard statistical approach for QC measurements.

Completeness

Project-specific completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample. The following calculation is used for determining the percent complete:

$$\text{Completeness} = \frac{A}{B} \times 100$$

Where:

A = Actual number of measurements judged valid (the validity of a measurement result is determined by judging its suitability for its intended use)

B = Total number of measurements planned to achieve a specified level of confidence in decision making

The formula for sampling completeness is:

$$\text{Sampling Completeness} = \frac{\text{Number of locations sampled}}{\text{Number of planned sample locations}} \times 100$$

An example formula for analytical completeness is:

$$\text{Metals Analytical Completeness} = \frac{\text{Number of Usable Data Points}}{\text{Expected Number of Usable Data Points}} \times 100$$

The ability to meet or exceed completeness objectives is dependent on the nature of samples submitted for analysis.

Graphics

Graphic figures will be generated to depict sample locations, as needed. Also, if necessary, figures

Worksheet 37 — Data Usability Assessment (Continued)

(UFP-QAPP Manual Section 5.2.3 and Table 12)
(EPA 2106-G-05 Section 2.5.2, 2.5.3, and 2.5.4)

will be generated to represent contaminant concentrations at each sampling location. Each figure will contain a detailed legend.

Reconciliation

PQOs will be examined to determine if the objective was met. This examination will include a combined overall assessment of the results of each analysis pertinent to an objective. Each analysis will first be evaluated separately in terms of the major impacts observed from the data verification and validation, DQIs, and MPC assessments. Based on the results of these assessments, the quality of the data will be determined. Based on the quality determined, the usability of the data for each analysis will be determined. Based on the combined usability of the data from all analyses for an objective, it will be determined if the PQO was met and whether project action limits were exceeded. As part of the reconciliation of each objective, conclusions will be drawn, and any limitations on the usability of any of the data will be described.

APPENDIX A
EPA REGION 8 QA DOCUMENT REVIEW CROSSWALK

APPENDIX B
SITE SPECIFIC DATA MANAGEMENT PLAN